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R-693

GUIDANCE SYSTEM OPERATIONS PLAN
FOR MANNED CM EARTH ORBITAL
MISSIONS USING PROGRAM SKYLARK I

SECTION 4 OPERATIONAL MODES
(REV. 01)

May 1972

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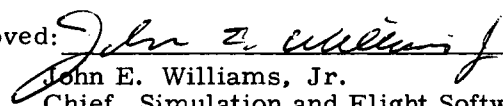
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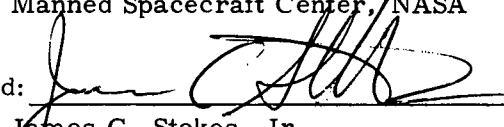
GUIDANCE SYSTEM OPERATIONS PLAN
FOR MANNED CM EARTH ORBITAL
MISSIONS USING PROGRAM
SKYLARK 1

SECTION 4 OPERATIONAL MODES
REVISION 01

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REVISION INDEX COVER SHEET
GUIDANCE SYSTEM OPERATIONS PLAN

GSOP No. R-693 Title: For Manned CM Earth Orbital
 Missions Using Program
 SKYLARK 1

Section No. 4 Title: Operational Modes

This section incorporates the following NASA/MSO approved changes to Colossus 3 (ART REV 72) and becomes the control document for SKYLARK I.

<u>PCR (PCN*)</u>		<u>PAGES/PROGRAMS AFFECTED</u>
003	Improved Short Burn Logic	P40, R00
004	Deletion of V94 (Cislunar Tracking)	VERBS
005	Deletion of V59 (Optics Cal. Mark)	VERBS, V59, p. 4-14, 4-18
006	Deletion of V52 (Offset Landing Site Mark)	VERBS
007	Deletion of V44 & 45 (Set and Reset of Surface Flag)	VERBS, P20, R31, R34, R61, V44, V45
008	Routine 57 Deletion (Optics Cal. Routine)	INDEX
009	Routine 33 Deletion	INDEX
010	Routine 05 Deletion (S-Band Antenna)	INDEX, VERBS, NOUNS, p. 4-11
011	Programs 72 thru 79 Deletion	INDEX, NOUNS, P20, P34, P35, P36, P38, P40, P41, R00, R07, R23, R31, p. 4-2
013	Deletion of Lunar Surface Alignment Option	P52, P54, OPT CODE
014	Program 39 Deletion	INDEX
015	Program 38 Deletion	INDEX
016	Program 37 Deletion	INDEX, OPT CODE, ALARMS, P20, P37 R22, p. 4-25

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<u>PCR (PCN*)</u>		<u>PAGES/PROGRAMS AFFECTED</u>
017	Program 23 Deletion	INDEX, NOUNS, CL CODES, P20, R22, R52, V67, V93
018	Program 22 Deletion	INDEX, NOUNS, P20, P51, R22, R52, R53, V67, V93
019	Program 24 Deletion	INDEX, NOUNS, P20, R52, R53
021	Program 32 Deletion	INDEX, NOUNS, P32, R07
025	Extended Range Capability	P20, P48, R22, R61
032	VHF Range Rate Computation & Display	INDEX, NOUNS, P20, P25, P48, R00, R08, R22, R27, p. 4-7
036	Compute ATM Star Tracker Gimbal Angles	INDEX, NOUNS, OPT CODE, ALARMS, P55, R00, R53
040	SKYLAB Digital Autopilot	INDEX, VERBS, NOUNS, P20, P40, P41, P52, P54, R00, R03, R04, R60, R62, V44, V45, V46, V59, V64
042	SKYLAB 4 Maneuver DKI Sequence	INDEX, P31, P32, P33
043	Moon Ephemeris Suppression in Skylab	P51, P52, P54, R56
400	Program 15 Deletion	INDEX, NOUNS, p. 4-4
405	Transform Optics Angles to Tracking Angles	INDEX, VERBS, R64, V64
410*	Delete Lunar Capability	INDEX, P20, P21, P29, P30, P51, P52, P54, P61, R30, R31, R34, R41, R56, R61, V46, p. 4-1
411*	Delete HAM Target- ing Program	P31, R07
412*	Delete ECSTEER	P34, P35, P36, P38
413	ATM Orientation Determination Program (P50)	INDEX, NOUNS, OPT CODE, P50, R00, R53, R56
414	Docked Alignment Capability in P51	P20, P51, P53, R53, R56
415	Docked Alignment Capability in P52	NOUNS, P20, P52, P54, R53, R56
416	Add Gyro Trim to R50	P52, P54, R50

PCR (PCN*)		PAGES/PROGRAMS AFFECTED
420	Display Separation Angle in N05	NOUNS, R54
421	Allow Overwrite of N59 in P36	P36
422*	Initialize Rendezvous Navigation to Update the CSM State Vector	P20
423	Change Conic to Precision Integration in All Rendezvous Tar- getting Programs	P36
424	Improve Minkey Gyro Torquing Logic	P52
434	Correct α_{ATM} in P50	P50
435*	Do not Automatically take VHF in P20	R07
436*	Nominal Use of ATM Sources in P52 and P54	P52, P53, P54, R56
438*	Incorrect Star Tracker Angle in P55	P55
439 REV 1	VHF Range Rate Filter Enable/Disable by Extended Verb	VERBS, R22, V76, V77
442*	Modification to R22	R22
443	Improved R61 Tracking	R61
445*	Modification #3 to Skylark Memo #14	P33
448	Modification #4 to Skylark Memo #14	ALARMS, P31, P32
450*	Add Check for G&N Auto at Start of R67	R67
452	Precision Integration for V90	R36
454	Docked DAP Alarm Codes	ALARMS, R04
455*	Change to P35, P36 and R00 to fix Anomaly ART 07	P35, P36, R00

PCR
(PCN*)

PAGES/PROGRAMS
AFFECTED

456*	Zeroing HOLDFLAG	P20, R00, R60, R61, R67, V56
457*	Editorial Changes to GSOP No. R-577 Section 4 Rev. 16	INDEX, VERBS, ALARMS, P00, P03, P27, P29, P30, P40, P52, P62, R21, R23, R36, R40, R41, R52, R53, R61, R63, R67, V41N20, V42, V57, V86, p. 4-4, 4-8, 4-11, 4-14, 4-15, 4-18, 4-24, 4-25, OPT CODE

The following Skylark Memos have been referenced as source material for the indicated changes.

SLM #2	Operational Modes for SKYLARK Rendezvous Program	INDEX, NOUNS, P20, P31, P32, P33, P34, P35, P36, P37, P38, P47, R00, R07, R23, R31
SLM #8	Modification of VHF R Proposals	P25, P48
SLM #19	VHF R Displays; P48 Change; R22/R27 in P20	INDEX, NOUNS, P20, P25, P48, R08, R22, R27
SLM #20	GSOP Modifications for SKYLARK Complex Impulsive Burn Logic	P40

Date: May, 1972

REVISION INDEX COVER SHEET
GUIDANCE SYSTEM OPERATIONS PLAN

GSOP No. R-693

Title: For Manned CM Earth Orbital
Missions Using Program
SKYLARK 1

Section No. 4

Title: Operational Modes (Revision 01)

This section incorporates the following NASA/MSC approved changes and becomes the control document for SKYLARK I (ART REV 72).

PCR (PCN*)		PAGES/PROGRAMS AFFECTED
459	VHFR Changes	P20, P25, P48, R27, V76
460	Legal Star Codes in P55 and P20	P20, P55
464	Let NN = 0 in P35	P35
468*	Current ϕ in R27 not computed during any integration	R27
470*	Add Possible Operator Error Light at V06N14 in R53	R53
489*	Editorial and Technical Changes to Skylark 1 Section 4 GSOP	4-5, 4-8, 4-17, 4-18, 4-21, P20, P25, P27, P31, P32, P33, P34, P35, P37, P38, P40, P41, P47, P48, P50, P51, P52, P53, P54, P55, P77, R00, R22, R23, R27, R30, R31, R34, R40, R53, R56, R60, R61, R64, R67, V35, V36, V40, V41(N20), V42, V55, V56, V61, V62, V63, V67, V69, V91, V96, VERBS, NOUNS, ALARMS

NOTE: For the numbered front pages, a row of dots in the margin indicates a change in specification authorized by the PCR (PCN*) listed at the bottom of the page.

For the computer-printed pages, all changes are indicated in the "PROG CONT" column by + signs bracketing the affected area and by the authorizing PCR/PCN number.

FOREWORD

SECTION 4

The Guidance System Operations Plan (GSOP) for Program SKYLARK 1 is published in five sections as separate volumes:

2. Data Links
3. Digital Autopilots
4. Operational Modes
5. Guidance Equations
7. Erasable Memory Programs

Since the information in Section 1 of the Colossus 2E GSOP is also applicable to the SKYLARK Program, Section 1 will not be re-published for SKYLARK. The reader is referred, therefore, to R577 Colossus 2E GSOP, Section 1, Revision 2, January 1970. Also, Section 6 will not be published for SKYLARK.

With this issue, Section 4 is revised from the previous issue of SKYLARK 1 (August, 1971), in order to reflect the NASA/ MSC-approved changes listed on the "Revision Index Cover Sheet" at the beginning of this volume.

This volume is published as a control document governing operational modes for SKYLARK 1, including GNCS interfaces with the flight crew and MCC. Revisions constituting changes to the SKYLARK 1 Program require NASA approval.

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4. GNCS OPERATIONAL MODES

4.0 Introduction

Preparation of the GNCS for any mission involves the generation of computer programs, flight and ground crew procedures, and the provision of hardware to meet interface, accuracy, and instrumentation requirements. All of these mission-related items are specified in the Guidance System Operations Plan.

The guidance operational concept is designed to comprise a set of manually-initiated programs and functions which may be arranged by the flight crew to implement a large class of flight plans. This concept of operation will permit both a late flight-plan definition and a capability for real-time flight-plan changes.

The GNC System is designed to perform the CM guidance and navigation functions required in a self-contained mode within specified accuracy and maneuver propellant constraints. The System is also designed to accept navigation data from earth-based facilities whenever required to improve accuracy, to reduce maneuver propellant requirements, or to gain some other operational advantage.

4.1 AGC Program Control

To efficiently coordinate the design of the AGC* Programs, as well as define the astronaut and ground control procedures with respect to the GNC system, it is necessary to define the operating inter-relationships between the GNC system, other S/C systems, the astronauts and the ground.

In primary GNCS control modes the AGC can automatically compute required mission parameters and automatically command both GNCS and CSM subsystems. Complete automation of this control throughout a mission is neither feasible nor desirable. For primary as well as secondary GNCS control modes the astronauts and/or the ground must be capable of initiation or termination of AGC Programs. These procedures must be thoroughly defined to permit the design of the AGC Program logic for astronaut/ground participation.

4.1.1 AGC Program Initiation

4.1.1.1 AGC Programs

Due to the random time sequencing of many of the AGC tasks the design of Programs capable of being utilized at varied times and in varied circumstances offers the best method of accomplishing these tasks. These Programs must incorporate sufficient logic to clearly define the particular time and/or application for which they are to be used. They must also standardize astronaut/AGC communication procedures, ground/AGC communication procedures and GNCS and SCS Mode determination.

A logical arrangement of these Programs has been supplemented by simpler routines not requiring identification as Programs. The programs, and their associated routines are outlined in detail in Section 4.4.

When a single program is in process in the AGC, its program number is displayed in the Program lights on the DSKY. When more than one program is in process at the same time, the program which is making primary use of the DSKY will be displayed. There are three cases of dual program operation: programs with P20 in background, P27 with P00, P02 or P20 in background, and P03 with P02 in background.

The AGC is programmed to initiate a Program only in response to the initiation of a specific mission task and will continue the programmed sequence of computations and displays for the specific task until Program completion or termination.

Programs are generally initiated by manual keyboard entry (astronaut) or by AGC UPLINK command (ground). In certain cases Program initiation is automatically performed by the preceding Program. The diagrams of Section 4.4 show Program selection as it should occur normally.

* AGC is an acronym for Apollo Guidance Computer. In the CSM, this computer is officially designated as the CMC (CM Guidance Computer).

4.1.1.2 Special AGC Routines

In addition to the AGC Programs there are many routines and subroutines not specifically identified with a Program. The majority of these are automatically performed in a particular computation or control sequence and involve no notification to the "outside world" that they are in process. While they may occasionally be referred to in this document their large number requires that detailed descriptions be restricted to special AGC program documents.

Several special routines are described in detail herein because of one or more of the following characteristics:

- (a) The routine involves AGC communication with the astronaut.
- (b) The routine is of importance in understanding the Programs.
- (c) The routine involves significant sequences of AGC/Astronaut action but could be performed while certain programs are in process.

These routines include those automatically called by the AGC as well as those manually called. If the routine required AGC/astronaut communication, it will start with a particular display which acts as a key to the astronaut that the AGC has automatically entered the routine.

4.1.2 AGC Program Termination

Normally there are two ways by which an AGC Program in process is terminated:

- 1. At completion, the program in process will transfer control to (a) the Final Automatic Request Terminate Routine (R00), (b) a subsequent Program.
- 2. Via a terminate response by the astronaut to an AGC generated flashing display on the DSKY (usually results in transferring control to R00).

In addition to the above, the astronaut may terminate a particular AGC Program as follows:

- 1. Select a new Program to operate via the DSKY.
- 2. Select a routine via the DSKY which has been specifically designed to terminate a particular program or activity (e. g. state vector integration).
- 3. Select the FRESH START routine which essentially initializes the AGC.

4.2 AGC/Astronaut/Ground Communications

4.2.1 AGC/Ground Communications

The AGC/Ground Communications are via the AGC UPLINK and AGC DOWN-LINK and are described in detail in Section 2 of the GSOP.

4.2.2 AGC/Astronaut Communications

The display and keyboard logic in the AGC processes information exchanged between the AGC and the computer operator. This information is exchanged via the display and keyboard (DSKY).

The modes of operation are basically:

- (a) Display of internal data - This includes simple displays and periodically updated displays of data; and displays of requests for operator action required by the AGC.
- (b) Loading of external data - the process of inserting data into the AGC via the DSKY.
- (c) Program or Routine calling - Initiated by operator action via the DSKY.

The following paragraphs and Table 4-1 (page 4-18) provide a limited description of the DSKY, and the crew/DSKY operating procedures. They are included herein to facilitate understanding of the Program logic in Section 4.4 and do not comprise a complete instruction manual for the use of the DSKY. For detailed DSKY operating instructions refer to other MIT documents.

4.2.2.1 The DSKY (refer to Figure 4-1 page 4-19)

(a) UPLINK ACTY Light

1. is energized by the first character of a digital UPLINK message received by the AGC. If the light is not extinguished by the UPLINK transmission it should be extinguished by crew use of the RSET or KEY REL buttons when the UPLINK transmission is complete.
2. is energized during the Universal Tracking program (P20) when the tracking attitude routine (R61) detects that the 10° test has failed (see Section 3. for criteria), that HOLDFLAG is not positive non-zero, and that the V50N18 Flag is not set.

- (b) NO ATT Light - is energized when the AGC is in operate mode and there is no inertial reference; i.e. the ISS is caged or in the coarse align mode.
- (c) STBY Light - is energized when the AGC is in standby mode and deenergized when the AGC is in operate mode.
- (d) KEY REL Light
 - (1) Energized when:
 - (a) An internal display comes up while astronaut has the DSKY.
 - (b) An astronaut keystroke is made when an internal flashing display is currently on the DSKY. (Note three exceptions: PRO (proceed), RSET (reset) and ENTR (enter) if ENTR is a single button response.)
 - (c) The astronaut makes a keystroke on top of (his own) Monitor Verb display. This is the so-called "suspended monitor" case. (Monitor Verbs display data updated every one second.)
 - (2) De-energized when:
 - (a) Astronaut relinquishes DSKY by hitting KEY REL button.
 - (b) Astronaut terminates his current sequence normally, e.g.
 - i) with final ENTR of a load sequence.
 - ii) the ENTR of a response to a flashing display.
 - iii) the ENTR of an extended verb request.
 - (3) Some special DSKY cases that may not be universally appreciated are:
 - (a) The astronaut may select a non-Monitor Verb display on top of his own previously selected Monitor Verb. This will cause KEY REL light to flash (See 1 (c) above). Hitting the KEY REL button will bring back (unsuspend) the monitor and extinguish the light. However, if these sequences are selected on top of an internal display, the KEY REL light will not go out as the monitor is unsuspended. It requires one more KEY REL button operation to extinguish the light and bring back the internal display.
 - (b) Suppose the astronaut selects another verb-noun combination (e.g. a V16 monitor) on top of an internal flashing

display. That internal display can still be answered with a PRO or VERB 34 ENTR (terminate), which wipes everything from the DSKY till the next internal display. Therefore, an astronaut selected monitor should, as a rule, never be terminated with VERB 34 ENTR, because that may not be the desired response to the flashing display. The KEY REL button should be used instead.

- (e) TEMP Light - the AGC receives a signal from the IMU when the stable member temperature is in the range 126.3°F to 134.3°F . In the absence of this signal, the TEMP light on the DSKY is actuated.
- (f) GIMBAL LOCK Light - energized when the middle gimbal angle exceeds $\pm 70^{\circ}$ from its zero position. When MGA exceeds $\pm 85^{\circ}$ the ISS is downmoded to Coarse Align and the No Attitude lamp on the DSKY is actuated except during Average-G when the "config" window of DAPDATR1 indicates Saturn configuration.
- (g) PROG Light - The program alarm actuates the PROG light on the DSKY. A program alarm is generated under a variety of situations. For further information relative to program alarm see Sections 4.3.3 and 4.3.4.
- (h) TRACKER Light
 - 1. Failure within the optics CDUs generates a fail discrete (Optics CDU Fail) which is an input to the computer. The TRACKER light is energized by this error signal. The discrete will be set if any or all of the following conditions in either OCDU exist for approximately 2-10 seconds.
 - a. CDU fine error - in excess of 1.0V rms
 - b. READ COUNTER limit cycle - in excess of 160 cps
 - c. $\cos(\theta - \phi)$ - below 2.0V
 - d. +14VDC supply - decrease to 50% of normal level
 - 2. In addition to the conditions described in (1.) the TRACKER light is energized when the VHF Range Read Routine (R08).

reads VHF Range data via the VHF DATA link but the DATA GOOD DISCRETE is missing. R08 is called by the rendezvous tracking data processing routine (R22) and the VHF range rate mark processing routine (R27).

3. It is de-energized if the DATA GOOD DISCRETE is present after reading VHF Range data and by keying in V88E.

It is also de-energized if the conditions described in (1.) and (2.) do not exist.

- (i) OPR ERR Light - is energized when the DSKY operator performs an improper sequence of key depressions. The light is de-energized by pressing the RSET button.
- (j) COMP ACTY Light - is energized when the AGC is occupied with an internal sequence. It is not an indicator of whether the operator may use the DSKY or whether the AGC is not capable of handling further computation.
- (k) RESTART Light - in the event of Restart during operate a latch is set in the AGC which maintains the RESTART light on the DSKY until the latch is manually reset by pressing the RSET button. For further detail see section 4.3.4.
- (l) Display Panel - consists of 24 electroluminescent sections arranged as in Fig. 4-1, page 4-19. Each section is capable of displaying any decimal character or remaining blank, except the 3 sign sections. These display a plus sign, a minus sign, or a blank. The numerical sections are grouped to form 3 data display registers, each of 5 numerical characters; and 3 control display registers, each of 2 numerical characters. The data display registers are referred to as R1, R2, R3. The control display registers are known as VERB, NOUN, and PROGRAM.

At maximum activity, the complete display panel may be updated in approximately 1/2 second.

- (m) Keyboard - contains the following buttons:

VERB - pushing the button indicates that the next two numerical characters keyed in are to be interpreted as the Verb Code.

NOUN - pushing the button indicates that the next two numerical characters keyed in are to be interpreted as the Noun Code.

+ and - sign keys used for sign convention and to identify decimal data.

0 - 9 -numerical keys.

CLR - used during a data loading sequence to clear or blank the data display register (R1, R2, R3) being used. It allows the operator to reload the data word.

PRO - this pushbutton performs two functions:

1. When the AGC is in a standby mode, pressing this button will put the AGC in the operate mode, turn off the STBY light (see (c)), update CMC time counter, and select Routine 00 in the AGC.
2. When the AGC is in the operate mode but Program 06 is not selected, pressing the button will provide the proceed function. Proceed directs the AGC to continue to the next programmed event. In response to an AGC request it further indicates crew compliance with the request. If the PRO button is pressed when the VERB lights contain verb 21, 22, or 23, the button is rejected and the OPR ERR light is energized.
- 2a. When the AGC is in the operate mode and Program 06 is selected, pressing the button will put the AGC in the standby mode and turn on the STBY light (see (c)).

KEY REL - releases the DSKY displays initiated by keyboard action so that the DSKY is available for displays generated by the AGC program.

ENTR - is used in three ways:

1. To direct the AGC to execute the Verb/Noun code now appearing on the Verb Noun lights.
2. To direct the AGC to accept a data word just loaded.
3. In response to a "please perform" request (see section 4.2.2.7).

RSET - turns off PROG light, RESTART light, and OPR ERR light; also clears R1 and R2 of the N09 registers containing the alarm code (FAILREG's).

4.2.2.2 Verbs and Nouns

The basic language of communication between the astronaut and the DSKY consists of Verb and Noun Codes. The Verb Code indicates what action is to be taken. The Noun Code indicates to what this action is applied.

Verb Noun codes may be originated either by manual operation or by the AGC Program in process.

The standard procedure for a manual keyboard operation consists of a sequence of 7 key depressions:

VERB V₁ V₂ NOUN N₁ N₂ ENTR

The VERB key depression blanks the Verb lights on the display panel and clears the Verb Code register within the computer. The next two numerical characters punched in are interpreted as the Verb Code. Each of these characters is displayed in the Verb lights on the display panel as it is punched in. The NOUN key operates similarly for the Noun lights and Noun Code register.

The depression of the ENTR key causes the performance of the Verb-Noun combination appearing in the lights at the time of depression. Thus it is not necessary to follow any order in punching in the Verb or Noun Code. They may be done in reverse order, or an old Verb or old Noun may be used without repunching it.

No action is ever taken in performing the Verb-Noun combination until ENTR is pressed. If an error is noticed in either the Verb Code or the Noun Code before the ENTR is pressed, correction is simple. Merely press the VERB or NOUN key and repunch the originally intended code, without necessarily changing the other. Only when the astronaut has verified that the desired Verb and Noun Codes are in the lights, should he press the ENTR key to execute the Verb-Noun combination.

A Noun Code can refer to a group of computer erasable registers, a group of counter registers, or may serve merely as a label. A label Noun refers to no particular computer registers, but conveys information by its Noun Code number only. The group of registers to which a Noun Code refers may be a group of 1, 2 or 3 members. These are generally referred to as 1, 2, or 3 component Nouns. The component is understood as a component member of the register group to which the Noun refers. The machine addresses for the registers to which a Noun refers are stored within the computer in Noun tables.

A single Noun Code refers to a group of 1, 2, or 3 component members. It is the Verb Code that determines which component member of the Noun group is operated on. Thus, for instance, there are 5 different Load Verbs. Verb 21 is required for loading the first component of whatever Noun is used therewith; Verb 22 loads the second component of the Noun; Verb 23, the third component; Verb 24, the first and second components of the Noun; and Verb 25 loads all three components of the Noun. A similar component format is used in the Display and Monitor Verbs.

When the decimal Display Verb is employed, all the component members of the Noun being used are scaled as appropriate, converted to decimal, and displayed in the data display registers.

Decimal data is identified by a + or - sign preceding the numerical characters. If decimal is used for loading data of any component members of a multi-component Load Verb, it must be used for all components of the Verb. Thus no mixture of decimal and octal data is permitted for different components of the same Load Verb. (If this is violated, the OPR ERR light is turned on.)

There is a class of verbs called Monitor Verbs which display data every one second. Once a Monitor Verb is executed, the data on the display panel continues to be updated until the Monitor is turned off.

The Monitor may be turned off by keying in: PRO, VERB 34 ENTR (terminate), VERB 32 ENTR (recycle), by internal program initiation of the Keyboard and Display System Program, (if the DSKY is not busy) or by a Fresh Start or Restart of the AGC.

Monitor action is suspended (but not ended) by the depression of any key, except RSET, KEY REL, and ENTR. This turns on the KEY REL light immediately. Monitor action continues after the Keyboard and Display System is released. Thus it is possible to suspend a monitor while the astronaut loads some data (or requests another display) and to return to the original monitor when his intervention is concluded.

After any use of the DSKY, the numerical characters (verb, noun, and data words) remain visible until the next use of the DSKY. If a particular use of the DSKY involves fewer than 3 data words, the data display registers (R1, R2, R3) not used remain unchanged, unless blanked by deliberate program action.

The DSKY procedures above were described for manual operation; however, the principles described remain the same for DSKY operation by the AGC Programs and routines.

As outlined in the Mission Programs (section 4.4) the majority of DSKY operations are of the following categories:

- a) Display - to display data to the operator. Display Verbs present data computed by the mission program.
- b) Load - to request a data load as described in detail below.
- c) Please Perform - to request an action from the astronaut.
(see section 4.2.2.7)
- d) Please Mark - to request the astronaut to push the "MARK" button for an optics sighting. (see section 4.2.2.8)

AGC initiated Verb/Noun combinations are either statically displayed or flashed. If static they identify data displayed only for astronaut information requiring no response from him. If the Verb/Noun is flashing, appropriate astronaut response is required as dictated by the Verb/Noun combination. In this case the AGC Program or Routine is interrupted until the astronaut responds appropriately, then the Verb/Noun flash is terminated and the Program or Routine is resumed. (In some cases, e.g. R31, and R34, the displays will be continuously updated until the flash is terminated).

An appropriate astronaut response to a flashing Verb/Noun should be a data load and ENTR, VERB 32 ENTR (recycle), PRO, or VERB 34 ENTR (terminate). The internal program response to any one of these astronaut responses varies according to the Verb/Noun flashing and the Program in process as described below and in Section 4.4.

4.2.2.3 Acceptance of Keys

The numerical keys, the CLR key, and the sign keys are rejected if struck after completion (final ENTR) of a data display or data load Verb. At such time, only the VERB, NOUN, ENTR, RSET, or KEY REL are accepted. Thus the data keys are accepted only after the control keys have instructed the program to accept them.

Similarly the plus (+) and minus (-) keys are accepted just before the first numerical character of R1, R2, R3 is punched in, and at no other time.

The 8 or 9 key is accepted only while defining a program number, a verb, a noun, or when loading a data word into R1, R2, or R3 which was preceded by a plus or minus sign. (If this is violated, the OPR ERR light is turned on.)

If more than two numerical characters are punched in while loading the Verb, Noun, or Program code in the noun register, or more than five numerical characters while loading a data word, the excess characters are not accepted.

4.2.2.4 Release of Keyboard and Display System

The Keyboard and Display System Program can be used by internal computer programs. However, any operator keyboard action (except RSET) makes the Keyboard and Display System Program busy to internal routines. The operator has control of the Keyboard and Display System until he wishes to release it. Thus he is assured that data he wishes to observe will not be replaced by internally initiated data displays. There are four cases in which the operator initiated normal displays will be replaced by internally initiated action. These are: in P40/P41 when the DSKY is blanked at T-35 seconds, in P20 when DSKY is blanked during return from R60 to R61 at end of maneuver, when P63 is initiated from P62, and at lift off when P11 is initiated. In general, it is recommended that the operator release the Keyboard and Display System for internal use when he has temporarily finished with it. This is done by pressing the KEY REL button.

If an internal program attempts to use the Keyboard and Display System, but finds that the astronaut has used it and not yet released it, the KEY REL light is turned on. When the astronaut finds it convenient, he should strike the

KEY REL button to allow the internal program to use the keyboard and display panel.

4.2.2.5 Display - Verb/Noun Flashing

This is an internally initiated action. The appropriate astronaut response to a flashing display Verb/Noun combination is:

- (a) Correct the data (see Section 4.2.2.6 below). Perform the appropriate Load Verb sequence. Upon the final ENTR, the program proceeds normally.
- (b) VERB 32 ENTR (recycle). This causes the program to return to a previous location.
- (c) PRO. This indicates acceptance of the displayed data, and a desire for the internal sequence to continue normally.
- (d) VERB 34 ENTR (terminate). The astronaut wishes to terminate the operation.

NOTE: Uncommon responses are defined in the program logic of Section 4.4.

4.2.2.6 Load - Verb/Noun Flashing

Whenever any data is to be loaded the Verb/Noun flashes. The flash occurs whether the data load is initiated by the AGC or by the astronaut. The appropriate data display register (R1, R2, or R3) is blanked in anticipation of the data load. Data is loaded in 5-character words and is displayed character-by-character in one of the 5-position data display registers as it is keyed in.

Numerical data is considered decimal if the data word is preceded by a plus or minus sign; if no sign is supplied it is considered octal. The plus and minus keys are accepted only when they precede the first numerical character of the data word; they are ignored at any other time. Both decimal and octal data may be loaded with high order zeros suppressed. If decimal is used for any component of a multi-component Load Verb, it must be used for all components of that Verb. No mixing of octal and decimal data is permitted for different components of the same Load Verb. (If this principle is violated, the OPR ERR light is turned on.)

The ENTR key must be pressed after each data word. This tells the program that the numerical word punched in is complete. The flash is turned off after the last ENTR of a loading sequence.

As data is loaded, it is temporarily stored in buffers. It is not placed into its final destination, as specified by the Noun Code, until the final ENTR of the load sequence.

If an attempt is made to key in more than 5 numerical characters in sequence, the sixth and subsequent characters are simply rejected. If the 8 or 9 key is punched during octal load (as identified by lack of a sign entry), it is rejected and the OPR ERR light is turned on.

In multi-component load situations, the appropriate single component Load Verbs are flashed one at a time. The computer always instructs the astronaut through a loading sequence. For example: the astronaut (or the internal program) initiates the sequence by selecting VERB 25, "load 3 components of:" (any 3-component noun will do). The Verb Code is changed to 21, "load first component of:" and the flash is turned on. VERB 21 continues to be flashed as the astronaut punches in the first word of data. When the ENTR is pressed, the Verb Code is changed to 22. Flashing continues while the astronaut punches the second data word. When ENTR is pressed, the Verb Code is changed to 23, "load third component," and again the flash continues while the third data word is punched in. When ENTR is pressed, the flash is turned off, and all three data words are placed in the locations specified by the Noun. Throughout the changing of the Verb Codes, the Noun Code is left unchanged.

The CLR button is used during data loading to remove errors in R1, R2, or R3. It allows the astronaut to begin loading the data word again. It does not clear the Program, Noun, or Verb lights. (The Noun lights are blanked by the NOUN key; the Verb lights, by the VERB key.) In the following discussions, the term Clearing Function will be used to mean blanking the data display register.

For single component Load Verbs, the CLR button depression performs the Clearing Function on whichever register is being loaded, provided that CLR is punched before data ENTR. Once ENTR is depressed, CLR does nothing. The only way to correct an error after the data ENTR for a single component Load Verb is to begin the Load Verb again.

For the 2- or 3-component Load Verbs, there is a retrograde sequencing feature of CLR. The first depression of the CLR button performs the Clearing Function on whichever register is being loaded. (CLR may be pressed after any character, before its ENTR.) Consecutive depressions of CLR perform the Clearing Function on the data display register preceding the current one, and also change the VERB light to indicate the register being acted upon until R1 is cleared. Any attempt to back up beyond R1 is simply ignored.

The retrograde sequencing of CLR operates only on data pertinent to the Load Verb which initiated the loading sequence. For example, if the initiating Load Verb was a load second component only, no backing-up action is possible.

4.2.2.7 Please Perform - Verb/Noun Flashing

This is always an internally initiated action, as astronaut response is always required to the "please perform" request; the Verb-Noun is always flashed, and the Program is interrupted. The "please perform" verb (50) is usually used with the "Checklist" noun (25) with an appropriate "checklist code" number in R1. The appropriate response is:

- (a) PRO to indicate an affirmative response to the request.
- (b) ENTR to indicate a negative response to the request.

4.2.2.8 Please Mark

The "please mark" verbs (51 and 53) are flashed when the AGC is prepared to accept optical sighting data upon the pushing of the "MARK" button and ENTER button, respectively. The logic associated with the "please mark" function is completely described in Section 4.4. Marking is also allowed during P20 option 0, 4 without the presence of a please mark verb.

4.2.2.9 Machine Address to be Specified

There is a class of Noun available to allow any machine address to be used. These are called "Machine Address to be Specified" Nouns. When the ENTR which causes the Verb-Noun combination to be executed senses a noun of this type, R3 is blanked and the flash is immediately turned on. The Verb Code is left unchanged. The astronaut should load the 5-octal-character complete machine address of interest. It is displayed in R3 as it is punched in. If an error is made in loading the address, the CLR may be used to remove it. Pressing ENTR causes the verb to be executed.

4.2.2.10 Program Selection

VERB 37 ENTR is used to select a Program. The ENTR causes the Noun display register to be blanked and the Verb Code to be flashed. The 2-character Program Code would then be loaded. For verification purposes, it is displayed as it is loaded in the Noun display register. The ENTR causes 1) the noun register to be blanked and the 37 remaining in the verb register to be non-flashing, 2) a request for the new Program to be entered, and 3) the new Program Code to be displayed (if allowed) in the Program display register.

4.2.2.11 Alarm Philosophy

The OPR ERR light is turned on when the astronaut performs some improper sequence of key depressions.

4.2.2.12 Illegal Verbs, Nouns and Combinations

The simplest alarm situation is an attempt to use an undefined (or spare) Verb Code or Noun Code. The OPR ERR light is turned on when the ENTR that attempts to execute the Verb/Noun combination is pressed. No further action is taken.

It is possible to choose a Verb that is defined and a Noun that is defined, but have the combination of Verb and Noun be illegal (for example, the "decimal display" Verb used with a Noun which is restricted to be "octal only"). The OPR ERR light is turned on at the ENTR that attempts to execute the Verb/Noun combination for display verbs and at the ENTR following the final data load for load verbs. No further action is taken.

Violation of the following principles causes the OPR ERR light to be turned on. No further action is taken.

- (a) An undefined (or spare) verb must not be used.
- (b) An undefined (or spare) noun must not be used.
- (c) In octal Display and Monitor Verbs and all Load verbs, the components number of the verb must not exceed the number of components in the noun. (Note, all "machine address to be specified" nouns are considered 3 component.)
- (d) The octal Display and Monitor Verbs must not be used with a "decimal only" noun.
- (e) The decimal Display and Monitor Verbs must not be used with an "octal only" noun.
- (f) The double precision decimal Display and Monitor Verbs (07, 17) must not be used with mixed nouns (codes 40-99).
- (g) No Load Verb (except V21, V22 and V23) may be used with a noun restricted to be "no load". All nouns having split MIN/SEC scale or 2 integers for any component are "no load" for the entire noun.
- (h) No input code other than those which are defined may be punched into the keyboard.

4.2.2.13 Illegal Data and Recycle

Many legal Verb/Noun combinations require the loading of additional data (either numerical or machine address). It is possible that the data supplied may itself be improper for the Noun selected. Examples are: (1) the numerical data exceeds the maximum value allowed by the scale factor associated with the Noun, and (2) decimal data is loaded into an "octal only" noun.

In general the offense is detected at the final ENTR of the loading sequence. The alarm is turned on and a recycle is performed back to the beginning of the loading sequence. The flash is left on, and the data display register associated with the first data word in the sequence is blanked again. It is necessary for the astronaut only to supply the data again; he need not attempt to re-execute the Verb/Noun combination. (Note, if decimal data is supplied for the address of a "machine address to be specified" noun, the alarm and recycle are performed at the ENTR immediately following the address keyed in.)

Violation of the following principles causes the OPR ERR light to be turned on, and a recycle to be performed.

- (a) The address keyed in for a "machine address to be specified" noun must be octal.
- (b) In multicomponent load verbs, no mixing of octal and decimal data is permitted. All the data words loaded for a given noun must either be all octal or all decimal.
- (c) Octal data must not be loaded into a "decimal only" noun.
- (d) Decimal data must not be loaded into an "octal only" noun.
- (e) Decimal data loaded must not numerically exceed the maximum permitted by the scale factor associated with the appropriate component of the noun.
- (f) Negative decimal data must not be loaded using the Y optics scale.
- (g) All 3 words must be loaded for the Hours, Minutes, Seconds scale.
- (h) When loading with the Hours, Minutes, Seconds scale, the minutes must not exceed 59; the seconds must not exceed 59.99; and the total magnitude must not exceed 745 hours, 39 minutes, 14.55 seconds.
- (i) Two numerical characters must be supplied for the Program Code under V37.

4.2.2.14 Operator Error and Key Rejection

There are five situations which cause the OPR ERR light to be turned on and the offending key depression to be simply rejected. These are:

- (a) An 8 or 9 is punched while loading a word which was not preceded by a plus or minus sign. The 8 or 9 is simply rejected. The remaining characters may then be supplied or the offending word removed and its loading begun again.
- (b) Certain program controlled cases (see Section 4.4).
- (c) An attempt to call an extended verb on top of a priority display or an attempt to call an extended verb with displays on top of another extended verb with displays without allowing proper termination of the first.
- (d) The PRO button may not be pressed when the VERB lights contain VERB 21, 22, or 23.
- (e) Neither V30E or V31E can be called if R1 of N26 is zero.

ASTRONAUT RESPONSE	DISPLAY OF INFORMATION		REQUEST FOR ASTRO ACTION		REQUEST FOR DATA LOAD	REQUEST FOR OPTICS MARK
	CMC Awaiting ASTRO Response V_N_Flashing	CMC Not Awaiting ASTRO V_N_Static	Request identified by V50, V97, V99, or V37.	Request identified by V53	Request identified by V and type of data by N. Loaded data appears in registers R1, R2, R3, At completion, key in "ENTER".	Request identified by V51. At completion of "MARK"s identify target (final entry is "ENTER")
Key in "ENTR"	No CMC Action	CMC Awaiting ASTRO Response V_N_Static	CMC assumes ASTRO did not comply, terminates flashing Verb-Noun, and continues	CMC assumes ASTRO complied	V_N_Flashing CMC takes loaded data, terminated flashing Verb-Noun and continues	CMC Always Awaiting ASTRO Response V51 Flashing V51: No CMC Action
Key in "PRO"	CMC assumes displayed data is correct, terminates flashing Verb-Noun, and continues	No CMC Action	CMC assumes ASTRO complied, terminates flashing Verb-Noun, and continues	In R23 CMC assumes ASTRO has taken sufficient marks, In R56 response is not accepted	Varies with program in progress	See appropriate routine in Section 4, 4
Key in "Terminate" (V34E)	Varies with program in progress	No CMC Action	Varies with program in process		Varies with program in process	Varies with program in process
Key in "Recycle" (V32E)	CMC returns to earlier point in sequence	No CMC Action	Incorrect Response		Incorrect response	V51: No CMC Action
Press MARK button	If there is no request for a mark at the time of key depression (P20 option 0, 4 not operating) the PROG Light is turned on. Marking is also allowed during P20 option 0 or 4 without the presence of a please mark verb. Pressing MARK will cause CMC to read 2 optics angles, 3 CDU angles and time and store for R22.					CMC reads 2 optics angles, 3 CDU angles, and time, terminates flashing Verb-Noun if a suitable number of marks have been made and continues

ASTRONAUT RESPONSE TO DSKY DISPLAYS
AND CMC RESULTANT ACTION

Table 4-1

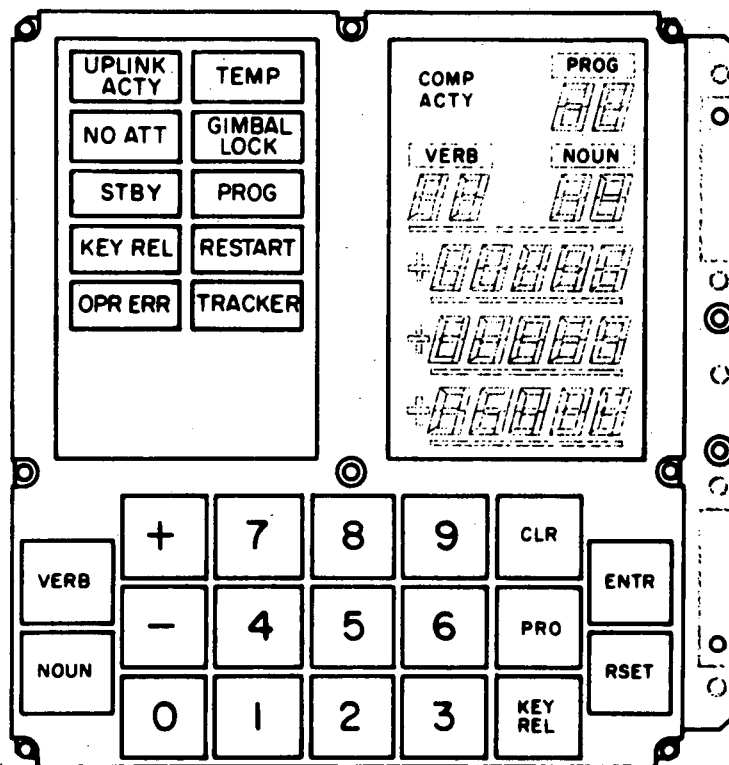


Fig. 4-1 Display and Control Panel

4.3 GNCS Failure Monitor

The GNCS performance and operational readiness are self-monitored and caution and warning information are displayed to the crew. Two warning (red) lamps are actuated by the GNCS on the Caution/Warning Panel: AGC Warning indicates computer failure; ISS warning indicates failure of the inertial subsystem. Also a GNCS Caution (amber) light is actuated to indicate non-critical problems in the system. Further detail regarding the caution items is displayed by means of the DSKY event lamps and the DSKY data registers (in the event of a program alarm).

4.3.1 AGC Warning

An AGC warning alarm is generated in the event of AGC power failure, scaler failure of either of two types, restart or counter failure during AGC operate, or in response to an alarm test program. A scaler fail or prime power fail result in an immediate alarm indication whereas the other inputs are buffered by a filter so as to prevent transient disturbances from causing a warning alarm. In this subsection the various inputs and conditions associated with AGC warning are defined.

- (a) SCAFAL - Occurs if scaler stage 17 (1.28-sec. period) fails to produce pulses. This provides a check on the timing for all logic alarms.
- (b) COUNTER FAIL - Occurs if counter increments happen too frequently or else fail to happen following an increment request. "Too frequently" means continuous counter requests and/or incrementing for from 0.625 to 1.875 ms.
- (c) SCADBL - Occurs if the 100 pps scaler stage operates at a pulse rate of 200 pps or more.
- (d) PARITY FAIL - Occurs if any accessed word in fixed or erasable memory whose address is octal 10 or greater contains an even number of "ones".
- (e) RUPT LOCK - Occurs if interrupt is either too long or too infrequent. The criterion for "too long" is phase dependent, varying in duration from 140 ms. to 300 ms. Likewise the criterion for "too infrequent" varies in absence from 140 ms to 300 ms.
- (f) TC TRAP - Occurs if too many consecutive TC or TCF instructions are run or TC or TCF instructions are too infrequent. The criterion for "too many" varies in duration from 5 ms to 15 ms. The criterion for "too infrequent" varies in absence from 5 ms to 15 ms.

(g) NIGHT WATCHMAN - Occurs if the computer should fail to access address octal 67 within a period whose duration varies from 0.64 sec. to 1.92 sec.

(h) V FAIL - Occurs if the AGC voltages (28, 14, 4) are out of limits. This signal produces STRT1 if it stays on for a period of between 157 and 470 μ sec. If the computer is in the STANDBY mode, an input to the AGC WARNING FILTER is generated simultaneously with STRT1. The following criteria apply for V FAIL:

4 V Supply > 4.4 V

14 V Supply > 16 V

4 V Supply < 3.65V

14 V Supply < 12.5V

28 V Supply < ~22.6V

(i) STANDBY - This is a signal which turns on RESTART and turns off the switchable +4 and +14 voltage, thus putting the AGC into a low power mode where only the scaler, timing signal, and a few auxiliary signals are operative. STANDBY is initiated by first setting the ENABLE STANDBY outbit (CH13 B11), and then pressing the PRO button on the DSKY for a time which varies from 0.64 sec. to 1.92 sec. at the end of which time the STANDBY light is turned on. (All AGC alarms are inhibited during the Standby mode with the exception of AGC WARNING, which can be caused by VOLTAGE FAIL or SCALER FAIL; and TEMPERATURE CAUTION, which can be caused by TEMP ALARM.) Normal operation is resumed by pressing the PRO Button on the DSKY again, time of depression same as above.

(j) RESTART - RESTART occurs at next time 12 following occurrence of any one or more of the following parameters: Rupt lock, TC Trap, Night Watchman, parity fail, and Standby as described above.

RESTART occurs immediately and forces time counter to 12 upon occurrence of OSCILLATOR FAIL. (See paragraph (1) below.)

RESTART causes the computer to transfer control to fixed memory address 4000₈ as soon as it disappears. It sets a flip-flop which lights the RESTART CAUTION lamp in the DSKY.

The flip-flop is reset either by the ALARM RESET hard-wired signal or by the CAUTION RESET outbit CH11 B10. ALARM TEST operates the lamp but not the flip-flop.

- (k) **WARNING FILTER** - This circuit is used to operate the AGC WARNING output following repeated or prolonged occurrences of any of certain parameters. All occurrences of these signals are stretched so that no more than one input to the filter is generated in each 160-millisecond period. Approximately six consecutive stretched pulses cause AGC WARNING to turn on for about 5 seconds. Non-consecutive stretched pulses may also cause AGC WARNING after an interval dependent on the frequency of the pulses. The output will not occur if input pulses occur at a frequency of less than 0.9 pps; and the output will remain on if pulses occur at a frequency of 0.6 pps or more. The threshold of the filter resumes its normal level with a time constant of many seconds after the filter has received inputs. An immediate reset of the AGC WARNING due to a WARNING FILTER output is therefore not possible.
- (l) **OSCILLATOR FAIL** - Occurs if the oscillator stops. Has nominal 250-millisecond delay to keep signal present after the oscillator starts. Also occurs when AGC is in STANDBY because of loss of power to front end of circuit. This results in a 250-millisecond delay in starting when AGC comes out of STANDBY into OPERATE and causes an immediate restart without waiting for time pulse 12.

4.3.2 ISS Warning

The ISS Warning signal is the logical "OR" of the following parameters, any one of which will cause an ISS Warning under the following conditions:

(a) **IMU Fail**

- (1) IG Servo Error - greater than 2.9 mr for 2 sec
- (2) MG Servo Error - greater than 2.9 mr for 2 sec
- (3) OG Servo Error - greater than 2.9 mr for 2 sec
- (4) 3200 cps supply - decrease to 50% of normal voltage level
- (5) 800 cps wheel supply - decrease to 50% of normal voltage level

These parameters are generated in the Inertial Subsystem. However, the "WARNING" signal itself is under AGC program control. It is ignored by the AGC program when the G&N system is in the Coarse Align Mode and during the 5-second interval following Coarse Align. During this mode the servo errors normally exceed the above criteria.

(b) **PIPA FAIL**

Pipa fail occurs if no pulses arrive from a PIPA during a 312.5-microsec period, or else if both plus and minus pulses occur, or if a "long

time" elapses without at least one plus pulse and at least one minus pulse arriving. By "long time" is meant a period between 1.28 sec. and 3.84 sec.

This FAIL signal is generated totally within the AGC and thus is completely under AGC program control. Its generation is enabled by the AGC only during AGC controlled translation or thrusting maneuvers.

- (c) ISS CDU FAIL (Monitored for each of 3 CDU's) Set if any or all of the following conditions exist for approximately 2-10 sec.
- (1) CDU fine error - in excess of 1.0 V rms
 - (2) CDU coarse error - in excess of 2.5 V rms
 - (3) READ COUNTER limit cycle - in excess of 160 cps
 - (4) $\cos(\theta - \phi)$ - below 2.0 V
 - (5) +14 VDC Supply - decrease to 50% of normal level

These parameters are generated in the Inertial Subsystem. However the response to the "FAIL" signal itself is under AGC program control. It is ignored by the AGC program for about 8 seconds after the CDU Zero Mode has been commanded. During this Mode the CDU errors normally exceed some of the above criteria.

4.3.3 GNCS Caution

The GNCS Caution lamp is actuated by the following undesirable and non-critical events:

- (a) CMC Restart during operation. In the event of Restart during operate a latch is set in the CMC which maintains the GNCS Caution alarm and the RESTART lamp on the DSKY until the latch is reset by the program or until the latch is manually reset by pressing the RSET button. For further detail see section 4.3.4.
- (b) Temperature out of Limits. The CMC receives a signal from the IMU when the stable member temperature is in the range 126.3°F to 134.3°F . In the absence of this signal, the Caution alarm and the TEMP lamp on the DSKY are actuated.
- (c) Gimbal Lock. When the CMC determines that the middle gimbal angle (MGA) of the IMU is greater than 70° , the Caution alarm and the Gimbal Lock lamp on the DSKY are actuated. When MGA exceeds 85° the ISS is downmoded to Coarse Align and the No Attitude lamp on the DSKY is actuated except during Average-G when the "config" window of DAPDATR1 indicates Saturn configuration.

- (d) Program Alarm. Under a variety of situations a program alarm is generated. One example is that of a PIPA fail when the vehicle is not in a thrusting mode. Under program control the CMC inhibits this program alarm for 10 sec. after system turn-on. The program alarm actuates the Caution alarm and the Program light on the DSKY. For further information see Section 4.3.4.

4.3.4 Restart and Program Alarms

Program Alarms

1. Alarm conditions are indicated by lighting the PROG ALARM light and storing the appropriate alarm code so that it may be examined by keying V05N09E. In some special cases V05N09 is automatically displayed. The light is turned off and R1, R2 of N09 are cleared by pressing the RSET button. For non-ABORT alarm conditions the normal program flow is not interrupted.

2. The ABORT type of alarm conditions preclude continuation of normal program flow; in these special cases recovery from the condition is accomplished by the software by means of a "software restart". These ABORT conditions are divided into two classes:

- a. "BAILOUT" alarms, designated by a five-digit alarm code with 3 as the first digit, e.g. 31201.

These alarms cause suspension of non-restartable program activity and continuation of only that program activity which is restartable. This type of alarm condition is generally due to temporary overloading of the system; the BAILOUT procedure will relieve the situation and allow continuation of the program.

- b. "POODOO" alarms, designated by a five-digit alarm code with 2 as the first digit, e.g., 21302.

These alarms are caused by conditions which are less likely to be correctable than the "BAILOUT" alarm conditions, e.g. inconsistencies in mathematical calculations. Software recovery procedures for POODOOS depend on program environment at the time:

- 1.) If AVERAGE G is active, the "BAILOUT" recovery procedure is followed.*
- 2.) If an extended verb is active, the "BAILOUT" recovery procedure is followed.*

* When a POODOO abort condition triggers a BAILOUT recovery procedure, the POODOO alarm code is retained.

3.) If neither of the above applies, current program flow is terminated and a flashing V37 is displayed, requesting astronaut selection of a new program.

3. Exit from a continuous "BAILOUT" loop can be accomplished by simultaneous depression of the RSET and MARK REJECT buttons, as in the case of a hardware restart loop. Exit from either a hardware or a software restart loop by means of the above will cause reinitialization of the software by a Fresh Start.

Restarts

Hardware restarts will light the Restart lamp on the DSKY.

4.3.5 Restart Protection

With the exception of P06, the pulse torquing option of P52 and P54 (following ENTR on V50N25, R1 = 00013 until V50N25, R1 = 00014), and in P52 following PRO on V50N25 R1 = 00020 until termination of P52, all programs are restart protected. All routines which are called by a program are restart protected. Restart logic is designed such that significant information is not lost due to a restart. Extended verb routines and manually called displays are not restart protected.

4.3.6 Channel 31, 33 Fail Bit Protection

A new erasable C31FLWRD has been defined which is examined by the AGC to determine if the channel representations of the CMC MODE SWITCH, SC CONTROL SWITCH, OPTICS MODE SWITCH, or OPTICS ZERO SWITCH are to be used or if back-up indications are to be used. The erasable is of the form AxxDx₈.

If A = 0 or 4, the CMC MODE SWITCH and SC CONTROL SWITCH indications are assumed valid. Other values of A cause the AGC to use a back-up indication as shown in Table I.

If D = 0 or 4, the OPTICS MODE SWITCH and OPTICS ZERO SWITCH indications are assumed valid. Other values of D cause the AGC to use a back-up indication as shown in Table II.

C31FLWRD is padloaded as 0xx0x. If the astronaut desires to bypass the channel representation, he should load C31FLWRD via V21 N01 to the values shown in Tables I and II.

Table I

A value	Meaning
1	G&N control FREE
2	G&N control ATT. HOLD
3	G&N control AUTO
5	SCS control FREE
6	SCS control ATT. HOLD
7	SCS control AUTO

Table II

D value	Meaning
1	OPTICS Mode CMC
2	OPTICS Mode ZERO
3	OPTICS Mode MANUAL
5	OPTICS Mode CMC
6	OPTICS Mode ZERO
7	OPTICS Mode MANUAL

4.4 AGC Logic/Ground/Crew Interface Diagrams Description

These diagrams outline the detailed logic of the inter-relationship between the AGC/Crew/Ground. For ease of correction and reproduction the diagrams have been incorporated in a computer memory and are presented as a computer printout.

The diagrams contain the following:

- 1) Program Control - Indication of sequence interruptions and the following display notation:

- a) PRIO (Priority) - denotes a priority display
- b) HOLD - denotes that the verb-noun and data will continue to be displayed until the astronaut takes DSKY action.
- c) TEMP HOLD (Temporary HOLD) - denotes that the duration of the display on the DSKY (non-flashing) is controlled by the AGC.
- d) POSS HOLD (Possible HOLD) - denotes that the display is a possible path taken by the AGC.
- e) MON (Monitor) - denotes that the displayed data is automatically updated and displayed by the AGC.
- f) SNAP - denotes that the displayed data is not automatically updated (monitored) by the AGC.

2) AGC

3) Ground

4) Crew

} The sequence logic and interface relationships of the AGC logic, ground operations and crew activities.

- 5) A line count is provided on the far right hand side of the page.

- 6) The AGC Program (or Routine) number and the PROGRAM assembly specification are printed on the lower right hand corner of each page e. g. P40/SKYLARK.

11	EARTH ORBIT INSERTION MONITOR
12	-----*
13	-----*
14	-----*
15	-----*
16	-----*
17	-----*
18	-----*
19	-----*
20	UNIVERSAL TRACKING
21	GROUND TRACK DETERMINATION
22	-----*
23	-----*
24	-----*
25	CONTINGENCY VHF RANGE RATE
26	-----*
27	CMC UPDATE
28	-----*
29	TIME OF LONGITUDE
30	EXTERNAL DELTA V
31	NC1 TARGETING
32	NC2 TARGETING
33	NCC TARGETING
34	NSR TARGETING
35	TPI TARGETING
36	TPM TARGETING
37	RENDEZVOUS FINAL PHASE
38	PLANE CHANGE TARGETING

	39	-----*	
THRUST- ING	40	SPS	
	41	RCS	
	42	-----*	
	43	-----*	
	44	-----*	
	45	-----*	
	46	-----*	
	47	THRUST MONITOR	
	48	RENDEZVOUS THRUST MONITOR	
	49	-----*	
ALIGN- MENT	50	ATM ORIENTATION DETERMINATION	
	51	IMU ORIENTATION DETERMINATION	
	52	IMU REALIGN	
	53	BACKUP IMU ORIENTATION DETERMINATION	
	54	BACKUP IMU REALIGN	
	55	ATM STAR TRACKER GIMBAL ANGLE	
	56	-----*	
	57	-----*	
	58	-----*	
	59	-----*	
ENTRY	60	-----*	
	61	ENTRY - PREPARATION	
	62	ENTRY - CM/SM SEPARATION AND PRE-ENTRY MANEUVER	
	63	ENTRY-INITIALIZATION	
	64	ENTRY - POST 0.05G	
	65	ENTRY - UP CONTROL	

66	ENTRY - BALLISTIC
67	ENTRY - FINAL PHASE
68	-----*
69	-----*
70	-----*
71	-----*
72	-----*
73	-----*
74	-----*
75	-----*
76	-----*
77	CSM VELOCITY VECTOR UPDATE
78	-----*
79	-----*

PCST
THRUSTING

	ROUTINE	ROUTINE TITLE
00		FINAL AUTOMATIC REQUEST TERMINATE
01		ERASABLE AND CHANNEL MODIFICATION
02		IMU STATUS CHECK
03		CSM DAP DATA LOAD
04		DOCKED DAP DATA LOAD
05		-----*
06		-----*
07		MINKEY CONTROLLER
08		VHF RANGE READ
09		-----*

10	-----*
11	-----*
12	-----*
13	-----*
14	-----*
15	-----*
16	-----*
17	-----*
18	-----*
19	-----*
20	-----*
21	RENDEZVOUS TRACKING SIGHTING MARK
22	RENDEZVOUS TRACKING DATA PROCESSING
23	RENDEZVOUS BACKUP SIGHTING MARK
24	-----*
25	-----*
26	-----*
27	VHF RANGE RATE MARK PROCESSING
28	-----*
29	-----*
30	ORBITAL PARAMETERS DISPLAY
31	RENDEZVOUS PARAMETER DISPLAY NO. 1
32	-----*
33	-----*
34	RENDEZVOUS PARAMETER DISPLAY NO. 2
35	-----*
36	RENDEZVOUS OUT-CF-PLANE DISPLAY
37	-----*
38	-----*

39	-----*
40	SPS THRUST FAIL
41	STATE VECTOR INTEGRATION (MID TO AVE)
42	-----*
43	-----*
44	-----*
45	-----*
46	-----*
47	-----*
48	-----*
49	-----*
50	COARSE ALIGN
51	-----*
52	AUTOMATIC OPTICS POSITIONING
53	SIGHTING MARK
54	SIGHTING DATA DISPLAY
55	GYRO TORQUING
56	ALTERNATE LOS SIGHTING MARK
57	-----*
58	-----*
59	-----*
60	ATTITUDE MANEUVER
61	TRACKING ATTITUDE
62	CREW-DEFINED MANEUVER
63	RENDEZVOUS FINAL ATTITUDE
64	OPTICS ANGLES TRANSFORM
65	-----*
66	-----*

	ROTATION
67	-----*
68	-----*
69	-----*
70	-----*
71	-----*
72	-----*
73	-----*
74	-----*
75	-----*
76	-----*
77	-----*
78	-----*
79	-----*

* THIS PROGRAM OR ROUTINE DOES NOT EXIST FOR ASSEMBLY SKYLARK

** THIS PROGRAM IS DOCUMENTED IN SECTION 1 OF R577

CHANGE CONTROL NOTES

REV 00 PCR 008,009,010,011,014,015,016,017,018,019,021,032,036,040,042,400,405,413, PCN 410,457, SL MEMO #2,#19

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REV 00 05/19/71

(1) TO PROVIDE A PROGRAM TO FULFILL THE FOLLOWING REQUIREMENTS:

- (A) PROVIDE AN INDICATION TO THE CREW THAT THE CMC IS ENGAGED IN NO CONTROL OR COMPUTATIONAL OPERATIONS WHICH MIGHT REQUIRE CONSIDERATION FOR COORDINATION WITH OTHER CREW TASKS IN PROGRESS.
- (B) TO MAINTAIN THE GVCS IN A CONDITION WHERE MANUAL ATTITUDE MANEUVERS CAN BE MADE BY THE CREW WITH MINIMAL CONCERN FOR THE GVCS (SEE ASSUMPTION 2).
- (C) MAINTAIN THE CMC IN A CONDITION OF READINESS FOR ENTRY INTO OTHER PROGRAMS EXCEPT DURING STATE VECTOR EXTRAPOLATION.
- TO UPDATE THE CSM AND OWS STATE VECTORS EVERY FOUR TIME STEPS.

(1) THE IMU MAY OR MAY NOT BE ON. IF ON, THE IMU IS INERTIALLY STABILIZED BUT NOT NECESSARILY ALIGNED TO AN ORIENTATION WHICH IS KNOWN TO THE CMC.

- (2) IF NON-GNCS CONTROLLED ATTITUDE MANEUVERS ARE MADE BY THE CREW CARE MUST BE TAKEN TO AVOID IMU GIMBAL LOCK. THE IMU GIMBAL ANGLES MAY BE MONITORED BY OBSERVING THE ICDSU (V16 N20) OR BY MONITORING THE FDAI BALL.
- (3) THE PROGRAM IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY.
- (4) THIS PROGRAM IS AUTOMATICALLY SELECTED BY V96E, WHICH MAY BE DONE DURING ANY PROGRAM. STATE VECTOR INTEGRATION IS PERMANENTLY INHIBITED FOLLOWING V96E. NORMAL INTEGRATION FUNCTIONS WILL RESUME AFTER SELECTION OF ANY PROGRAM OR EXTENDED VERB. P00 INTEGRATION WILL RESUME WHEN P00 IS RESELECTED. USAGE OF V96 CAN CAUSE INCORRECT W-MATRIX AND STATE VECTOR SYNCHRONIZATION.

CREW

GROUND

343

CREW PROG
SELECTION

CMC PROG
SELECTION

KEY IN CMC IDLING
PROGRAM (POO)
V37E 00E

```

.....
.
DO R00 TO START CMC
IDLING PROGRAM 00
DISPLAY PROGRAM 00
.....

```

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MUNITZOR DSKY:

...

1

RESET
QUIT
FLAG

PROGRAM SELECTION. NAUT ACTION

EXTRAPOLATE PERMAN-
ENT STATE VECTORS
FORWARD TO PRESENT
TIME AS DEFINED
IN SECTION 5

3

!

A diagram of a rectangular room. A dashed line runs vertically through the center of the room. The text "WAIT 10 MINUTES." is written vertically along this dashed line. The room is bounded by solid lines on the top, bottom, and sides. There are small dots along the top and bottom edges of the room, and a small cluster of dots in the bottom right corner.

013 37 P00/SKYLARK

#70

CHANGE CONTROL NOTES

REV 00 PCN 457

POO/SKYLARK

#30

040

#50

09#

#70

016

REMOVE COARSE ALIGN
COMMAND (RELEASE
PLATFORM).

TURN OFF "NO ATT"
LIGHT

OBSERVE "NO ATT"
LIGHT OFF

TERMINATE PROGRAM 01
AND GO TO GYRO
COMPASSING PROGRAM
(P02)

MONITOR DSKY:
OBSERVE TERMINATION
OF P01 AND DISPLAY
OF P02

EXIT POL

EXIT POL

CHANGE CONTROL NOTES

08*

06#

#100

GYRO COMPASSING PROGRAM (P02) REF 00 05/19/71

- PURPOSE: (1) TO PROVIDE THE PROPER STABLE MEMBER ORIENTATION FOR LAUNCH.
- ASSUMPTIONS: (1) THIS PROGRAM MAY BE INTERRUPTED TO PERFORM THE OPTICAL VERIFICATION OF GYRO COMPASSING PROGRAM (P03).
 (2) V75 WILL BE KEYED IN AND DISPLAYED DURING THIS PROGRAM TO PERMIT CREW BACKUP OF THE LIFTOFF DISCRETE.
 (3) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE INITIALIZATION PROGRAM (P01).
 (4) THIS PROGRAM HAS THE CAPABILITY (VIA V78E) TO CHANGE LAUNCH AZIMUTH OF THE STABLE MEMBER WHILE GYROCOMPASSING.

PROG
CONT

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CREW

GROUND

CMC

- AGC
- PROG
- SELECTION
-
-

START GYRO
COMPASSING PROGRAM
(P02)
DISPLAY PROGRAM 02

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 02

SET TIMER

DO VERTICAL
ERECTION

PRECEDING PAGE BLANK NOT FILMED

#10

#20

#30

HAS TIMER
REACHED 640
SECS?

DU JYON COMPASS-
ING

WAIT 0.5 SECONDS

DO I WISH TO CHANGE
LAUNCH AZIMUTH OF
STABLE MEMBER?

```

HOLD .
.....
SNAP .
      FLASH VERB-NOUN TO
      REQUEST PROCTED AND
      DISPLAY STORED
      LAUNCH AZIMUTH
          V06 N29
      R1-XSM LAUYCH AZIMUTH
      P2-BLANK

```

R3-BLANK

XSM LAUNCH AZIMUTH
MEASURED CLOCKWISE
FROM TRUE NORTH IN
DEGREES TO NEAREST
01 DEGREESMONITOR DSKY:
OBSERVE VERB-NUUN
FLASH TO REQUEST
PROCEED AND DISPLAY
OF XSM LAUNCH
AZIMUTH

#90

#100

AM I SATISFIED
WITH XSM LAUNCH
AZIMUTH?

.Y .N

WAIT FOR KEYBOARD
ENTRYKEY IN V2IE AND
LOAD NEW LAUNCH
AZIMUTH

#110

TERMINATE FLASH
UPON RECEIPT OF PRO-
CEED OR NEW DATA

KEY IN PROCEED

.P .NEW
.R .DATA
.O .
.C .
.E .
.E STORE
.D NEW
DATA

#120

SET TIMER

#130

#190

PO2/SKYLARK

```

LC FROM : ..... START MONITOR OF
SIVB : ..... LIFT OFF DISCRETE
TU -----
      • LU
      • OR
      •
      •
      •
      •
      •

```


TURN OFF OPERA-
TOR ERROR LIGHT

#30

• EXIT

MONITOR OSKY:
OBSERVE DISPLAY OF
PROGRAM 03

第40

START OPTICAL
VERIFICATION OF
GYRO COMPASSING
PROGRAM (P031).
DISPLAY PROGRAM 03

05#

CONTINUE GYRO
COMPASSING

WAIT 0.5
SECONDS

09#

SET TARG IDENT TO
000001 IN R3 OF NOUN 30

02

PASTE VJ5N30 AND
THEN V06N41 (DO NOT
OVERWRITE R3)

HCLD .
.....
SNAP .

FLASH VERB-NOUN TO
REQUEST PROCEED AND
DISPLAY STORED
TARGET 1 AZIMUTH AND
ELEVATION:
V06 N41
R1-TARG AZ
R2-TARG ELEV
R3-TARG IDENT

TARG AZ-TARGET
AZIMUTH-ANGLE CLOCK-
WISE FROM TRUE NORTH
TO THE TARGET. IN
DEGREES TO NEAREST
.01 DEGREE

TARG ELEV-TARGET
ELEVATION-ANGLE FROM
THE LOCAL HORIZONTAL
(OF NAV BASE) TO THE
TARGET. IN DEGREES
TO NEAREST .001
DEGREE

TARG IDENT-TARGET
IDENTIFIER-IDENTIFI-
ES AZIMUTH AND
ELEVATION FOR TARGET
1 OR 2

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PROCEED AND DISPLAY
OF TARGET 1 AZIMUTH
AND ELEVATION

AM I SATISFIED WITH
THE AZIMUTH AND
ELEVATION OF TARGET
1?

.Y .N

#80

#90

#100

#110

[illegible]

ELEVATION:

V06 N41
R1-TARG AZ
R2-TARG ELEV
R3-TARG IDENT

TARG AZ-TARGET
AZIMUTH-ANGLE CLOCK-
WISE FROM TRUE NORTH
TO THE TARGET. IN
DEGREES TO NEAREST
.01 DEGREE

TARG ELEV-TARGET
ELEVATION-ANGLE FROM
THE LOCAL HORIZONTAL
(OF NAV BASE) TO THE
TARGET. IN DEGREES
TO NEAREST .001
DEGREE

TARG IDENT-TARGET
IDENTIFIER-IDENTIFI-
ES AZIMUTH AND
ELEVATION FOR TARGET
1 OR 2

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

P. NEW
R. DATA
O. .
C. .
E. .
E. STORE NEW
O. DATA

COMPUTE LOS TO
TARGET NUMBER ONE

OF TARGET 2 AZIMUTH
AND ELEVATION

AM I SATISFIED WITH
THE AZIMUTH AND
ELEVATION OF TARGET
2?

.Y .N

KEY IN PROCEED

KEY IN V21E,V22E,
OR V24E AND LOAD NEW
DATA

#180

#190

#200

#210

#220

AND DRIVE OPTICS,
IF ALLOWED.

#230

HOLD

FLASH VERB TO
REQUEST PLEASE MARK

V51N BLANK

R1-BLANK

R2-BLANK

R3-BLANK

(NOTE: VOUN AND R1
WILL NOT BE BLANK IF
ENTERED FROM MARK
REJ. AFTER V50N25,
R1 = 00J16 DISPLAY)

MONITOR DSKY:

OBSERVE VERB

FLASH TO REQUEST

PLEASE MARK

#240

#250

SELECT CMC OPTICS

MODE, OBSERVE SXT

DRIVE (OPTIONAL).

#260

SELECT MANUAL OPTICS

MODE

#270

WAIT FOR MARK

TERMINATE FLASH UPON

RECEIPT OF MARK

MARK

WHEN SIGHTING ON

TARGET 1 IS SATIS-

FACTORY PRESS MARK

BUTTON

; 030

P03/SKYLARK

STORE MARK DATA

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM TERMINATE MARK

V50 N25
R1-00016
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE FLASHING
VERB-NOUN TO REQUEST
PLEASE PERFORM TERM-
INATE MARK SEQUENCE

WAS SIGHTING SATIS-
FACTORY?

$$\mathbb{Z} \quad \mathbb{Y}$$

```

-----
WAIT FOR KEYBOARD
ENTRY
      . REJECT
      .....
      .

```

PRESS MARK
REJECT. BUTTON

TERMINATE FLASH UPON
RECEIPT OF
PROCEED OR REJECT

 .REJECT .PROCEED

ERASE LAST
SET OF MARK.

#310

#320

#280

#290

#300

COMPUTE LOS TO
TARGET NUMBER
TWO AND DRIVE
OPTICS IF
ALLOWED.

```

.....
.
.
.
-----
MONITOR DSKY:
OBSERVE VERB
FLASH TO REQUEST
PLEASE MARK

```

• • • • •

• • • • •

```

- - - - -
SELECT CMC OPTICS      .
MODE. OBSERVE SXT     .
DRIVE (OPTIONAL)      .

```

SELECT MANUAL OPTICS
MODE

032

0430

〇うき

#450

0940

0244

P03/SKYLARK

034

WAIT FOR KEYBOARD
ENTRY

CONFER WITH GROUND.
ARE GYRO MISALIGN-
MENT ANGLES ACCEPT-
ABLE?

.N .Y
.
.

SHALL I CONTIN-
UE WITH BAD
DATA?

.NO .YES
.
.

KEY IN TER-
MINATE
V34E

EXIT

HAVE I
ZEROED
THE X
AND Y
GYRO
ERROR?

.N .Y
.
.

KEY IN V24E AND
LOAD R1 AND R2
WITH ZEROES.

#480

#490

#500

#510

#520

#530

#540

#550

#560

#570

036

TERMINATE FLASH UPON
RECEIPT OF TERMINATE
OR PROCEED OR NEW
DATA

• T • NEW
• R • DATA
• O •
• C •
• E •
• D •
• A •
• T •
• E •

STORE NEW
DATA

TERMINATE P03
AND REDISPLAY
P02. CONTINUE
GYRO COMPAS-
SING.

EXIT P03

KEY IN PROCEED

.
. .
. .
. .
. .
. .
. .
. .
. .

TORQUE Z GYRO PER
ERROR

.
. .
. .

TERMINATE P03 AND
REDISPLAY P02.
CONTINUE GYRO
COMPASSING.

.
. .
. .
. .
. .

EXIT P03

CHANGE CONTROL NOTES

REV 00 PCN 457

037

61
P03/SKYLARK

#580

#590

P03/SKYLARK

CMC POWER DOWN PROGRAM (P06)

REV 00 05/19/71

PURPOSE:

(1) TO TRANSFER THE CMC FROM THE OPERATE TO THE STANDBY CONDITION.

ASSUMPTIONS:

(1) WHEN THIS PROGRAM IS TURNED ON THE ASTRONAUT MUST POWER DOWN THE CMC TO STANDBY. HOWEVER, THE PROGRAM IS NOT RESTART PROTECTED.

(2) THE NORMAL CONDITION OF READINESS OF THE GNCs WHEN NOT IN USE IS STANDBY. ALL THE G/N CKT BKRS (PANEL 5) ARE CLOSED, THE IMU AND OPTICS G/N POWER SWITCHES (LEB PANEL 100) ARE OFF AND THE CMC STANDBY LIGHT (DSKY) IS ON. IN THIS CONDITION THE IMU IS IN STANDBY WITH ONLY HEATER POWER ON, OPTICS POWER IS OFF AND THE CMC IS IN STANDBY.

(3) A POSSIBLE CONDITION OF READINESS OF THE GNCs WHEN NOT COMPLETELY ON IS THE SAME AS STANDBY (2) ABOVE, EXCEPT THE CMC STANDBY LIGHT ON THE MAIN AND LEB DSKYS IS OFF. IN THIS CONFIGURATION THE CMC IS RUNNING FOR COMPUTATIONAL PURPOSES THAT DO NOT REQUIRE THE IMU OR OPTICS.

(4) IF THE COMPUTER POWER IS SWITCHED OFF IT WILL BE NECESSARY TO PERFORM A COMPUTER FRESH START (V36E) TO INITIALIZE THE ERASABLE STORAGE. THE CMC UPDATE PROGRAM (P27) WOULD HAVE TO BE DONE TO UPDATE THE STATE VECTOR AND COMPUTER CLOCK TIME.

(5) THE CMC IS CAPABLE OF MAINTAINING AN ACCURATE VALUE OF GROUND ELAPSED TIME (GET) FOR ONLY 23 HRS WHEN IN THE STANDBY MODE. IF THE CMC IS NOT BROUGHT OUT OF THE STANDBY CONDITION TO THE RUNNING CONDITION (SEE (3) ABOVE) AT LEAST ONCE WITHIN 23 HOURS THE CMC VALUE OF GET MUST BE UPDATED.

(6) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG
CONT

CMC GROUND CREW

• CREW PROG
• SELECTION
•
•
•

DO NOT TO START CMC
POWER DOWN
PROGRAM (P06)
DISPLAY PROGRAM 06

KEY IN CMC POWER
DOWN PROGRAM (P06)
V37E 06E

#10

PRECEDING PAGE BLANK NOT FILMED

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040

#70

#80

#90

#100

#110

#120

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED
(STANDBY) BUTTON
AND HOLD ON

TERMINATE FLASH UPON
RECEIPT OF STANDBY
ENTRY

STANDBY ENTER,
ENTRY V3E,
(PROCEED) TERM-
INATE
.
.
.
.
.
.
.

TURN ON STANDBY
LIGHT

OBSERVE STANDBY
LIGHT TO COME ON.

PUT CMC IN STANDBY.
BLANK ALL DSKY
LIGHTS

MONITOR DSKY:
OBSERVE ALL DSKY
LIGHTS TO GO BLANK.

RELEASE PROCEED
(STANDBY) BUTTON

EXIT P06

NOTE: WHEN IT IS DESIRED TO BRING THE CMC FROM STANDBY TO OPERATE THE FOLLOWING PROCEDURES APPLY.

041

**WAIT FOR
STANDBY ENTRY**

KEY IN PROCEED
(STANDBY) BUTTON
AND HOLD ON

#150

TURN OFF STANDBY
LIGHT

OBSERVE STANDBY
LIGHT TO GO OFF

**CLEAR STANDBY
ENABLE DISCRETE.**

RELEASE PROCEED
(STANDBY) BUTTON

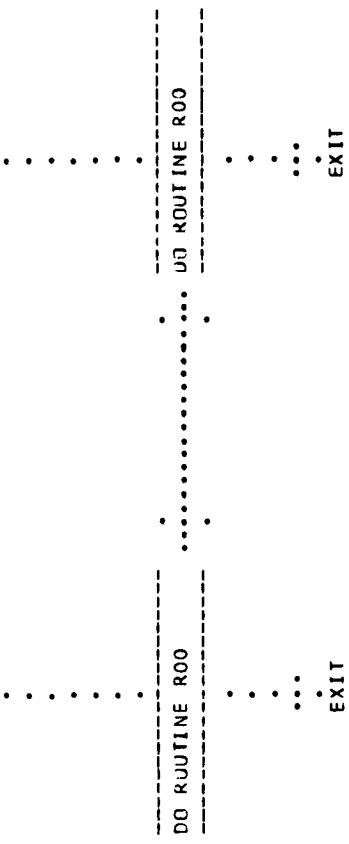
0914

RESET NODDOLAG

RELEASE PROCEED
(STANDBY) BUTTON

UPDATE CMC
TIME COUNTER

1170



#180

CHANGE CONTROL NOTES

SEND EFFECTIVE TIME
OF LIFTOFF ON
DOWNLINK

VERIFY AUTOMATIC
START OF DIGITAL
EVENT TIMER

ZERO CMC CLOCK

#20

UPDATE TEPHEM TO
TIME OF LIFTOFF

#30

CALL AVERAGE
G INTEGRATION
WITH DELTA V
INTEGRATION

#40

SET NODJP01
FLAG

#50

SWITCH TO POWE-
RED FLIGHT DOWN-
LIST

TERMINATE GYRO-
COMPASSING

#60

#70

COMPUTE INITIAL
STATE VECTOR

COMPUTE REFSMMAT

SET REFSMMAT FLAG

STORE LIFTOFF
ATTITUDE

WAIT 0.5 SEC BEFORE
STARTING ATTITUDE
ERROR COMPUTATION

CALL ROUTINE TO
LOAD ICDU DACS WITH
PITCH, ROLL, AND YAW
ATTITUDE ERRORS DE-
RIVED FROM PRESENT
ATTITUDE AND STORED
LIFTOFF ATTITUDE
UNTIL PRESENT TIME
EQUALS TEL (STORED
IN ERASABLE MEMORY)
AT WHICH TIME THE

MONITOR:
(A) FDOI ATTITUDE
ERROR NEEDLES AS
INDICATION OF
GMC COMPUTATIONS
OF INSERTION.

NOTE: DURING A
NOMINAL LAUNCH
AND AFTER SEPAR-
ATION OF THE LET

#100

#110

DURING MODE II,
 THE ASTRONAUT
 SHOULD NOTE THE
 GRADUAL SATURA-
 TION OF THE
 PITCH NEEDLE.

BALL INDICATES
INITIAL VEHICLE
ROLLOUT AND THEN
GRADUAL PITCH-
OVER.

(B) DSKY: R1-VI INCREASING
R2-HDOT FOLLOWS
NOMINAL HISTORY
R3-H INCREASING

Y06 Y62

V06 V62
R1 - VI
R2 - HDO
R3 - H

VI-INERTIAL VELOCITY MAGNITUDE. IN FPS TO NEAREST FPS

SHOOT - RATE OF
CHANGE OF VEHICLE
ALTITUDE ABOVE
LAUNCH PAD RADIUS.
IN FPS TO
NEAREST FPS

HH-VEHICLE ALTITUDE
ABOVE THE LAUNCH
PAD RADIUS. IN NAUTI-
CAL MILES TO
NEAREST .1 NM

 TERMINATE P11 AND GO
 TO PROGRAM SELECTED

KEY IN V37EXXE

048

PILL/SKYLARK

049 73 P11/SKYLARK

VIA R00

...
EXIT P11

#170

...
EXIT P11

CHANGE CONTROL NOTES

P11/SKYLARK

UNIVERSAL TRACKING PROGRAM (P20)

REV 01 03/20/72

PURPOSE:

(1) TO CONTROL CSM ATTITUDE/OPTICS OR ATTITUDE RATES DEPENDING ON WHICH OF THE FIVE OPTIONS IS SELECTED. THEY ARE AS FOLLOWS:

- OPTION 0 - POINT SPECIFIED SPACECRAFT VECTOR ALONG LOS TO OWS WITHOUT CONSTRAINING ROTATION ABOUT VECTOR (VECPNT). THIS OPTION IS USED TO ACQUIRE THE OWS IN THE SXT FIELD.
 - OPTION 1 - POINT SPECIFIED SPACECRAFT VECTOR AT SPECIFIED HEAVENLY BODY WITHOUT CONSTRAINING ROTATION ABOUT VECTOR (VECPNT). THIS OPTION DOES NOT EMPLOY OPTICS DRIVE.
 - OPTION 2 - PERFORM ROTATION ABOUT SPECIFIED SPACECRAFT VECTOR AT SPECIFIED RATE AND BEGINNING AT SPECIFIED TIME. THIS OPTION IS NORMALLY USED TO EFFECT PTC. THIS OPTION DOES NOT EMPLOY OPTICS DRIVE.
 - OPTION 4 - POINT SPECIFIED SPACECRAFT VECTOR ALONG LOS TO OWS, ALSO CONSTRAINING ROTATION ABOUT VECTOR (3-AXIS). THIS OPTION IS USED TO ACQUIRE THE OWS IN THE SXT FIELD AND IS AUTOMATICALLY ENABLED BY THE MINKEY CONTROLLER.
 - OPTION 5 - POINT SPECIFIED SPACECRAFT VECTOR AT SPECIFIED HEAVENLY BODY, ALSO CONSTRAINING ROTATION ABOUT VECTOR (3-AXIS). THIS OPTION DOES NOT EMPLOY OPTICS DRIVE.
- (2) TO UPDATE EITHER THE OWS OR CSM STATE VECTOR (AS SPECIFIED BY THE ASTRONAUT BY DSKY ENTRY) ON THE BASIS OF OPTICAL TRACKING DATA AND/OR VHF RANGE DATA (OPTIONS 0 AND 4 ONLY). TO UPDATE THE CSM AND OWS STATE VECTORS EVERY FOUR TIME STEPS (OPTIONS 1,2 AND 5 ONLY)

ASSUMPTIONS:

- (1) THE IMU MUST BE ON AND ALIGNED IN ORDER TO PERFORM THIS PROGRAM.
- (2) THE GNCS IS IN CONTROL OF THE VEHICLE IN THE AUTO MODE IN THE NOMINAL CASE. IF THE ASTRONAUT TAKES OVER CONTROL OF THE VEHICLE WITH RHC THE CSM WILL REMAIN AT THE ATTITUDE IT IS DRIVEN TO. REGARDLESS OF MODE SELECTION THE GNCS WILL CALCULATE THE DESIRED TRACKING ATTITUDE.
- (3) ROUTINE R03 (R04 FOR CSM-OWS DOCKED) HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM, IN ORDER FOR THE GNCS TO PERFORM THE AUTOMATIC ATTITUDE MANEUVERS THE ASTRONAUT SHOULD KEY IN V46E (V45E FOR CSM-OWS DOCKED) AT SOME TIME PRIOR TO THE FIRST MANEUVER.
- (4) THE OWS OPTICAL BEACON IS VISIBLE TO THE CSM. (OPTIONS 0 OR 4).
- (5) THE OPERATION OF THE PROGRAM INCLUDES THE FOLLOWING FLAGS:

RENDEZVOUS FLAG- CONTROLS THE PERMANENT TERMINATION OF THE TOTAL RENDEZVOUS NAVIGATION PROCESS, OPTION 0,4. THESE OPTIONS WILL ONLY RUN OR RESUME RUNNING WHEN THIS FLAG IS SET. SET BY P20 SELECTION OF OPTION 0 OR 4. RESET BY P20 SELECTION OF OPTION 1,2 OR 5. SELECTION OF CMC IDLING PROGRAM(P00), CMC POWER DOWN PROGRAM(P06), CONTINGENCY VHF RANGE RATE PROGRAM(P25), RENDEZVOUS THRUST MONITOR PROGRAM(P48), OR BY V56E, P00D00 OR V34E FROM R60 OR R22. THE KEYING IN OF V56E WILL IMMEDIATELY TERMINATE P20 UNLESS A NAVIGATION MEASUREMENT IS BEING PROCESSED IN WHICH CASE IT WILL HOLD UNTIL COMPLETION OF THE INCORPORATION AND THEN TERMINATE P20.

TRACK FLAG- CONTROLS THE TEMPORARY TERMINATION OF THE TRACKING PROCESS. RESET OF THIS FLAG INTERRUPTS THE AUTOMATIC ATTITUDE MANEUVER/OPTICS POINTING PROCESS, AS WELL AS THE STATE VECTOR UPDATE PROCESS. THE SET OF THIS FLAG ENABLES ALL THESE PROCESSES. SET BY P20,21,29,30,31,32,33,34,35,36,37 AND 38. SET BY P52, P54 SELECTION IF OPTION 2 OF P20 IS RUNNING. RESET BY ANY V37EXXE, P00D00 AND V56E.

P20/SKYLARK

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++
+01
+
+489
++

SNAPFLAG - INHIBITS R22 MARK PROCESSING DURING CDU-SNAPSHOT AT TIME TD IN R27. SET BY R27 20 SEC. BEFORE TD. RESET IN R27 AFTER TC AND ALSO BY ANY V37EXXE.

UPDATE FLAG- CONTROLS THE TEMPORARY TERMINATION OF THE STATE VECTOR UPDATE PROCESS ONLY. SET BY P20 (OPTION 0 OR 4), 30,31,32,33,34,35,36,37,38 SELECTION. RESET BY ANY V37EXXE, V56E, AND IT IS ALSO RESET AND SET DURING THE PRETHRUST COMPUTATIONS TO PROTECT ERASABLE MEMORY.

STICK FLAG - RESET BY EXECUTION OF A PROGRAM CHANGE VIA R00 AND BY V58E. SET BY TAKING RHC OUT OF DETENT WHEN THE SC CONTROL SWITCH IS CMC AND WHEN THE THC IS NOT CLOCKWISE. CDU RATE DRIVE IS NOT PERFORMED IF THE STICK FLAG IS SET. SET BY RCS DAP WHEN MIDDLE GIMBAL ANGLE IS GREATER THAN + OR - 75 DEGREES DURING AN AUTOMATIC MANEUVER.

STATE VECTOR FLAG - DEFINES WHICH STATE VECTOR WILL BE UPDATED BY SIGHTING MARKS AND VHF RANGING. SET TO CSM BY P20 TURN ON AND V81E. SET TO OWS BY V80E.

VHF RANGE FLAG - SET BY V87E, RESET BY V88E. ALLOWS AUTOMATIC VHF RANGE DATA TO BE USED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22).

AZIMFLAG- SET BY SELECTION OF MINKEY AND P20 (OPTIONS 4 OR 5) TO CONSTRAIN ATTITUDE ABOUT POINTING VECTOR. RESET BY SELECTION OF P20 (OPTIONS 1,2, OR 5).

V50N18 FLAG - SET BY V37EXXE (EXCEPT XX=00) AND BY V58E: RESET BY R61.

UTFLAG- CONTROLS THE PERMANENT TERMINATION OF THE UNIVERSAL TRACKING PROGRAM P20, OPTIONS 1,2,5. THESE OPTIONS WILL ONLY RUN OR RESUME RUNNING WHEN THIS FLAG IS SET. SET BY SELECTION OF P20 OPTIONS 1,2, OR 5. RESET BY SELECTION OF P20 OPTIONS 0 OR 4 AND BY SELECTION OF CMC IDLING PROGRAM (P00), CMC POWER DOWN PROGRAM (P06), BY V56E, P00D00, IMU TURNOFF, OR V34E FROM R63.

R27FLAG- SET BY V76E AND RESET BY V77E AND AT P20 SELECTION. ALLOWS R22 TO CALL THE VHF RANGE-RATE MARK PROCESSING ROUTINE (R27).

R67FLAG- INDICATES THAT R67 (ROTATION ROUTINE) IS ACTIVE. SET WHEN R67 IS INITIATED OR RESTARTED. RESET IN R67 IF TRACKFLG IS RESET, BY V56E, AND BY SELECTION OF V37EXXE.

(6) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY AND BY MINKEY. IT MAY BE TERMINATED BY THE SELECTION OF THE CMC IDLING PROGRAM (P00), CMC POWER DOWN PROGRAM (P06), V34E FROM R60 OR R22, OR BY V56E. P20 SELECTION WILL TERMINATE P20 AND ANY OTHER PROGRAM IN PROCESS AND ESTABLISH P00. ALL OTHER PROGRAMS SELECTED WILL CHANGE THE PROGRAM NUMBER DISPLAYED ON THE DSKY BUT WILL NOT TERMINATE P20. THIS PROGRAM IS DESIGNED TO OPERATE AUTOMATICALLY AND SIMULTANEOUSLY WITH ANOTHER PROGRAM WITHOUT REQUIRING USE OF THE DSKY UNLESS NON-NOMINAL CIRCUMSTANCES REQUIRE CMC COMMUNICATION WITH THE ASTRONAUT. IF V56E IS KEYPED INTO THE DSKY AND P20 IS THE ONLY PROGRAM RUNNING, ROUTINE R00 WILL BE INITIATED.

(7) W-MATRIX INITIALIZATION FOR RENDEZVOUS MAY BE ENABLED IN ANY OF THE FOLLOWING WAYS:

- (A) KEYING IN OF VERB 93E
- (B) COMPUTER FRESH START (KEYING IN OF VERB 36E)
- (C) STATE VECTOR UPDATE FROM THE GROUND
- (D) DURING MINKEY BY AUTOMATIC W-MATRIX INITIALIZATION.

(8) THERE IS A RENDEZVOUS OPTICS MARK COUNTER USED IN THE CMC TO COUNT THE NUMBER OF OPTICS MARKS USED TO CHANGE EITHER STATE VECTOR AND THERE IS A RENDEZVOUS VHF RANGING MARK COUNTER USED IN THE CMC TO COUNT THE NUMBER OF VHF RANGING MARKS USED TO CHANGE EITHER STATE VECTOR.

THESE COUNTERS ARE ZEROED BY SEVERAL DISTINCT EVENTS, THEY ARE:

- (A) INITIALIZATION OF THE W-MATRIX FOR RENDEZVOUS (FOR ANY REASON, SEE ASSUMPTION 7).
- (B) KEYING V36E (REQUEST FOR FRESH START)
- (9) SUMMARY OF EXTENDED VERBS ASSOCIATED WITH THE PROGRAM:
 - V54E - DO R23 - ALLOWS BACKUP MARKING UN THE OWS.
 - V56E - RESET THE RENDEZVOUS FLAG, RESET UTFLAG. CAUSES TERMINATION OF P20.
 - V57E - ALLOWS CREW TO CHANGE SETTING OF FULL TRACK FLAG.
 - V58E - RESET STICK FLAG, SET V50N18 FLAG - ALLOW AUTO MANEUVERS
 - V67E - W-MATRIX RSS ERROR DISPLAY
 - V76E - ENABLE R27 (DURING P20 OPTION 0,4)
 - V77E - DISABLE R27 (DURING P20 OPTION 0,4)
 - V80E - SET STATE VECTOR FLAG TO OWS. DATA WILL UPDATE OWS STATE VECTOR
 - V81E - SET STATE VECTOR FLAG TO CSM. DATA WILL UPDATE CSM STATE VECTOR
 - V87E - SET VHF RANGE FLAG - ALLOWS R22 TO ACCEPT RANGE DATA.
 - V88E - RESET VHF RANGE FLAG - STOPS ACCEPTANCE OF RANGE DATA BY R22.
 - V93E - RESET REVDWFLG - CAUSE INITIALIZATION OF W-MATRIX FOR RENDEZVOUS AT NEXT DATA INCORPORATION

(10) PROGRAMS ALLOWING P20 TO RJN IN BACKGROUND (SET TRACKFLG):

PROGRAM NUMBER:	COMPATIBLE OPTIONS:				
	0	1	2	4	5
P21*	X	X	X	X	X
P27		X	X		X
P29*	X	X	X	X	X
P30	X	X	X	X	X
P31-P38	X			X	
P52				X	
P54				X	

* TRACKING ONLY (NO NAVIGATION).

(11) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88, HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(12) INFORMATION FROM THE VHF RANGE RATE MARK PROCESSING ROUTINE (R27) IS AVAILABLE IN OPTIONS 0 AND 4 IF R27 HAS BEEN ENABLED IN P20 BY V76E.

THE NOUNS ASSOCIATED WITH R27 ARE:

- N72 - TIME OF R27 OPTIMIZATION (TD)
- N76 - R1 - RANGE - VHF RANGE TO OWS IN NAUT. MI. TO .01 NM
- R2 - RANGE-RATE - RANGE-RATE BETWEEN CSM, OWS CALCULATED BY VHF RANGE-RATE FILTER IN FPS TO NEAREST .1 FPS. NEGATIVE SIGN INDICATES CLOSING
- R3 - TFO TIME FROM NOW TO OPTIMIZATION TIME (N72) IN MIN AND SEC TO NEAREST SEC. THE VALUE IS +59B59 IF V3 OPTIMIZATION WAS REQUESTED.

N76 CONTAINS EITHER CURRENT OR CONVERGING VALUES OF RANGE-RATE AS SHOWN IN TABLE BELOW

++
+01
+
+
+
+
+
+

N77 R1 - RANGE
R2 - RANGE-RATE
R3 - PHI OR -00001 - THE ANGLE IN DEGREES TO NEAREST .01 DEGREE BETWEEN THE LOCAL HORIZONTAL AND THE
SEXTANT LINE-OF SIGHT.

N77 CONTAINS CURRENT, CONVERGING OR OPTIMIZED VALUES OF RANGE AND RATE. THE ANGLE PHI IS EITHER THE CURRENT
ANGLE OR THE ANGLE AT OPTIMIZATION TIME.

		T)		OPTIMIZATION		TIME (N72)			

#20

.....
 MONITOR DSKY:
 OBSERVE DISPLAY
 OF P20

#30

ENTRANCE.
 WHEN .
 V37E20E .
 IS KEYED.
 AND WHEN.
 THE REN-
 DEZVOUS .
 FLAG OR .
 UTFLAG .
 IS AL- .
 READY .
 SET BUT .
 WHEN 20 .
 IS NOT .
 IN THE .
 MODE .
 LIGHTS.
 (SEE .
 ROO)

#40

....
 GO TO
 "F"
 BELOW

#50

DO IMU STATUS CHECK
 ROUTINE (R02)

.....

DO IMU STATUS CHECK
 ROUTINE (R02)

#60

SET DEADBAND TO DAP
 DEADBAND

.....

AND OMICRON
TO PREFER-
RED VALUES
GAMMA=0.00
DEG
RHO=-35.00
DEG
OMICRON=
00.00 DEG

#120

GO TO
"B"
BELOW

#130

POSS
HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OPTION CODE
FOR ASSUMED TRACKING
MODE:
V04ND6
R1 - 00024
R2 - 0000X
R3 - BLANK

R1 IS OPTION CODE
FOR ASSUMED TRACKING
MODE.

R2 IS ASSUMED
OPTION:
0 = RENDEZVOUS
(VECPPOINT)
1 = TARGET POINT-
ING (VEC-
POINT)
2 = ROTATION
4 = RENDEZVOUS

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED TRACKING
MODE.

IS THIS THE CORRECT
OPTION CODE?

.Y .N

(3AXIS)
5 = TARGET POINT-
ING (3AXIS)

#160

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED

#170

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW JATA.

KEY IN V2E AND
LOAD THE CORRE-
CT OPTION CODE.

#180

NEW
DATA
STORE NEW
DATA

IS THIS OPTION
0 OR 4?

#190

SET ASSUMED GAMMA,
RHO, AND OMICRON
TO PREFERRED VALUES:
GAMMA = 0
RHO = -J5 DEG
OMICRON = 0

#200

POSS
HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY DESIRED
SPACECRAFT VECTOR

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

#210

ANGLES AND Y-AXIS
CONSTRAINT.

V6N78
R1 - GAMMA
R2 - RHQ
R3 - UMICRON

ALL ANGLES IN DE-
GREES TO NEAREST
.01 DEGREE.
REFER TO SECT. 5 OF
THIS DOCUMENT FOR
DEFINITION OF
PARAMETERS

OF DESIRED SPACE-
CRAFT VECTOR ANGLES
AND Y-AXIS
CONSTRAINT.

AM I SATISFIED WITH
THESE VALUES?

.Y .N

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

.NEW .P
.DATA .R
. .O
STORE NEW .C
DATA .E
. .E
. .D

KEY IN V25E
AND LOAD THE
CORRECT VALUES.

PCSS
+OLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY ROTATION
RATE AND DEADBAND.

MONITOR DSKY:
RESERVE VER3-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

#220

#230

#240

#250

#260

#270

UF ROTATION RATE
AND DEADBAND.

V06N79
R1 - RATE
R2 - DEADBAND
R3 - BLANK

R1 - SPACECRAFT RATE
IN DEG/SEC TO THE
NEAREST .0001 DEG/
SEC. R1 IS BLANK
EXCEPT FOR OPTION 2

AM I SATISFIED
WITH THESE VALUES?

#280

R2 - SPACECRAFT
DEADBAND IN DEGREES
TO THE NEAREST .01
DEGREE.

.Y .N

#290

KEY IN
PROCEED

WAIT FOR KEYBOARD
ENTRY

#300

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V21E, V22E,
OR V24E AND LOAD THE
CORRECT VALUES.

.P
.R
.D
.C
.E
.E
.D
STORE NEW
DATA

#310

IS OPTION = 4 OR 5?

.Y .N

P20/SKYLARK

#370

#380

#390

#400

#410

#420

062 P20/SKYLARK

RESET RENDEZVOUS
FLAG

IS OPTION = 2?

.N .Y
.(1 JR .
-5)
...
GO TO
"C"
BELOW

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CELESTIAL
BODY CODE.

VOIN70
R1 - 000DE
R2 - BLANK
R3 - BLANK

R1-DE-DESIRED CELES-
TIAL BODY CODE

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW
CATA.

.NEW .P

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF CELESTIAL BODY
CODE.

IS THIS THE CORRECT
CODE?

.Y .N
.
.
.
.

KEY IN
PROCEED

KEY IN V21E AND
LOAD THE CORRECT
CODE.

"Q"
REFLUM

#470

PCSS
HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY PLANET
POSITION VECTOR.

V06N08
R1 - X PL
R2 - Y PL
R3 - Z PL

X PL - THE X COMPO-
NENT OF THE UNIT
POSITION VECTOR OF
THE PLANET AT GET.
IN REFERENCE COORDI-
NATES TO THE FIFTH
PLACE (.XXXXX).

Y PL - SAME AS X PL
FOR Y COMPONENT.

Z PL - SAME AS X PL
FOR Z COMPONENT.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

NEW
DATA
P
R
O
C
E
D

STORE NEW
DATA

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF PLANET POSITION
VECTOR.

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y .N

KEY IN
PROCEED

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS.

#480

#490

#500

#510

#520

064

P20/SKYLARK

#530

045#

#550

#560

#570

\$580

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

NEW
DATA

P
R
D
C
E
E
D

STORE NEW
DATA

STORE TIME IN
R67TIME

WDW

IS UTFLAG SET?

NO YES

EXTRAPOLATE PERMA-
NENT STATE VECTORS

KEY IN V25E AND LOAD
THE CORRECT VALUE.

#590

#600

#610

#620

#630

067

91
P20/SKYLARK

(C4S AND CSM) TO THE
PRESENT TIME USING
PRECISION INTEGRA-
TION.

SET RENDEZVOUS
FLAG

CALL THE RENDEZVOUS
TRACKING DATA PRO-
CESSING ROUTINE
(R22)

THE RENDEZVOUS TRAC-
KING DATA PROCESSING
ROUTINE (R22) IS NOW
AUTOMATIC

REDO
P20
(SEE ROJ)
CALL P00
TYPE IN-
TEGRA-
TION

IS THIS
MINKEY
SELECTION
OF P20?

.NO .YES

#640

#650

#660

#670

P20/SKYLARK

#680

0690

0018

#710

#720

068

P20/SKYLARK

069

93
P20/SKYLARK

#730

#740

#750

#760

#770

P20/SKYLARK

GO TO
NEW
BELOW

COMMAND ZERO
VEHICLE RATE

IS HOLDFLAG
NEGATIVE?

.Y N.

SET HOLDFLAG
ZERO

SET DAP REFER-
ENCE TO DESIRED
DAP CDUS

CLEAR RESTORE DAP
R21MARK DEADBAND
FLAG

RESET R67-
FLAG

++
+01
+
+489
++

0820

#790

0800

010

#820

020

P20/SKYLARK

#830

#840

#850

#860

#870

IS TRACK FLAG SET?

.Y .N

COMMAND ZERO
VEHICLE RATE

IS HOLDFLAG
NEGATIVE?

.Y .N

SET HOLDFLAG
ZERO

SET DAP REFER-
ENCE TO DESIRED
DAP COUS

RESET R67FLAG

++
+01
+
+489
++

#930

START R27 TIME
MCNITOR

SET R21MARK FLAG TO
ALLOW OPTICS MARKS

#940

DO TRACKING ATTITUDE
ROUTINE (R61) WHICH
MAY CALL ATTITUDE
MANEUVER ROUTINE
(R60)

DO TRACKING ATTITUDE
ROUTINE (R61) WHICH
MAY CALL ATTITUDE
MANEUVER ROUTINE
(R60)

#950

IS THIS A FORCED
MANEUVER DURING
MINKEY - (PLANE
CHANGE OR P37)?
(PCMANFLG SET?)

.NO .YES

RETURN
TO MINKEY
CONTROLLER
(R07)

#970

SET TARGIFLG FOR USE
BY AUTO OPTICS

POSITIONING ROUTINE
(R52).

.....
.
.

#980

CALL THE AUTO OPTICS
POSITIONING ROUTINE
(R52)

THE AUTO OPTICS POS-
ITIONING ROUTINE
(R52) AND THE TRACK-
ING ATTITUDE ROUTINE
(R61) ARE NOW AUTO-
MATIC.

#990

DO I DESIRE TO
TERMINATE P20?

.Y .N

#1000

"G"

DO I DESIRE TO
SELECT CMC IDLING
PROGRAM(P00)?

.Y .N

WAIT FOR KEYBOARD
ENTRY.

SELECT CMC
IDLING PROGRAM
(P00).
KEY IN
V37E00E

#1020

RESPONSE TO V56E
OR V37E00E
IMMEDIATELY.

.V .V
.5 .3
. .
. .
. .

#1030

074

CHANGE CONTROL NOTES

REV 00 PCR 007,011,016,017,018,019,025,032,040,414,415, PCN 410,422,456, SKYLARK MEMO #2, #19
REV 01 PCR 459,460, PCN 489

GROUND TRACK DETERMINATION PROGRAM (P21)

REV 00 05/19/71

PURPOSE:

(11) TO PROVIDE THE ASTRONAUT DETAILS OF HIS GROUND TRACK WITHOUT THE NEED FOR GROUND COMMUNICATION.

ASSUMPTIONS:

(1) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(2) THIS PROGRAM MAY BE SELECTED WHILE THE CSM IS IN EARTH ORBIT TO DEFINE THE GROUND TRACK OF EITHER THE DWS OR CSM.

(13) THIS PROGRAM ASSUMES THE VEHICLE WHOSE GROUND TRACK PARAMETERS ARE CALCULATED TO REMAIN IN FREE FALL FROM THE PRESENT TIME UNTIL T LAT LONG.

PROG
CONT

343

GRUND

CREW

• CREW
• PROGRAM
• SELECTION
•
•
•

00 000 TO START
GROUND TRACK
DETERMINATION
PROGRAM (P21).
DISPLAY PROGRAM 21

KEY IN GROUND TRACK
DETERMINATION
PROGRAM (P21)
V37E21E

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 21

SET TRACK FLAG

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SET CMC ASSUMED
OPTION TO 00001.

R2 IS THE CMC
ASSUMED OPTION:
00001 - THIS VEHICLE
00002 - OTHER VEHICLE

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

```

.P
.R
.Q
.C
.E

```

IS THE ASSUMED
OPTION CORRECT?

**KEY IN
PROCEED**

KEY IN V22E
AND LOAD THE
DESIRED OPTION
INTO R2

080 P21/SKYLARK

NEW
DATA

#90

#100

#110

#120

#130

P21/SKYLARK

ZERO T LAT LONG
DISPLAY REGIS-
TERS. R1, R2,
AND R3 WILL
INITIALLY READ
C0000

HOLD

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY T LAT LONG:
V06 V34
R1-T LAT LONG-HRS
R2-T LAT LONG-MIN
R3-T LAT LONG-SECS

T LAT LONG - TIME
(GET) AT WHICH LAT
AND LONG OF VEHICLE
POSITION IS DESIRED
IN HRS, MINS, SECS
TO NEAREST .01 SEC.

MONITOR DSKY:

OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF T LAT LONG.

DO I WISH TO HAVE
THE CMC COMPUTE
PARAMETERS FOR THE
PRESENT TIME?

.N .Y

AM I SATISFIED
WITH THE DIS-

PLAYED TIME?

.N
.Y

ARE ALL
THREE RE-
GISTERS
EQUAL TO
ZERO?

.Y .N

KEY IN
PROCEED

KEY IN V25E AND LOAD
NEW DATA.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF NEW DATA
OR PROCEED

.NEW .P
.DATA .R
. .O
. .C
STORE .E
NEW .E
DATA .D

IS T LAT LONG ZERO?

.N .Y

CHANGE T LAT LONG
TO PRESENT TIME

#140

#150

#160

#170

#180

083

107
P21/SKYLARK

#190

#200

#210

#220

#230

P21/SKYLARK

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. .
. .
. .
. .
. .
. .
. .
. .

CALCULATE VELOCITY
AND FLIGHT PATH
ANGLE FOR DISPLAY IN
N73 AT ASTRONAUT
REQUEST.

.
. .
. .

CALCULATE LATITUDE,
LONGITUDE AND ALTI-
TUDE OF VEHICLE AT
T LAT LONG

.
. .
. .

CALCULATE ALTITUDE
FOR DISPLAY IN N73
AT ASTRONAUT
REQUEST.

.
. .
. .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY LATITUDE,
LONGITUDE AND
ALTITUDE:

V06 N+3
R1-LAT
R2-LONG
R3-ALT

LAT-LATITUDE OF
VEHICLE. + IS NORTH.
IN DEGREES TO NEAR-
EST .01 DEGREE.

HOLD ..
.....
SNAP ..

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF LATITUDE, LONGI-
TUDE AND ALTITUDE

.
. .
. .
. .
. .
. .
. .
. .
. .

LONG-LONGITUDE OF
VEHICLE. + IS EAST.
IN DEGREES TO NEAR-
EST .01 DEGREE.

ALT-ALTITUDE OF
VEHICLE ABOVE THE
LAUNCH PAD RADIUS.
IN NAUTICAL MILES TO
NEAREST .1 NM.

#240

#250

#260

#270

#280

DO I WISH TO OBTAIN
NEW PARAMETERS FOR
A TIME 10 MIN.
FROM NOW OR ANY TIME
OTHER THAN THAT
WHICH APPLIES TO
PRESENT DISPLAY?

.N
.Y

WHEN FINISHED
WITH DISPLAY
KEY IN
PROCEED

WAIT FOR KEYBOARD
ENTRY

WHEN FINISHED
WITH DISPLAY KEY
IN RECYCLE
V32E

TERMINATE FLASH UPON
RECEIPT OF RECYCLE
OR PROCEED

.P
.R
.O
.C
.Y

085

109
P21/SKYLARK

#290

***300**

CHANGE CONTROL NOTES

REV 00 PCN 410

P21/SKYLARK

REV 01 03/20/72

CONTINGENCY VHF RANGE RATE PROGRAM (P25)

- PURPOSE:
- ++ (1) TO DISPLAY TO THE ASTRONAUT RANGE AND RANGE RATE FROM A SOURCE INDEPENDENT OF THE VEHICLE STATE VECTORS.
 - +01 (2) TO ALLOW THE ASTRONAUT TO SELECT A SEQUENCE OF TIMES FOR WHICH THE RANGE RATE WILL BE OPTIMIZED.
 - + ASSUMPTIONS: (1) THE VHF MUST BE OPERATING.
 - + (2) IF THE ASTRONAUT LOADS N72 WITH A TIME IN THE FUTURE, OPTIMIZATIONS WILL OCCUR AUTOMATICALLY EVERY 4 MINUTES, BEGINNING WITH THAT TIME (N72) SELECTED BY THE ASTRONAUT.
 - +459 (3) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.
 - ++

PROG
CONT

CREW

GROUND

CMC

•CREW PROG
•SELECTION
.
.
...

DO R00 TO START
CONTINGENCY VHF
RANGE RATE PROGRAM
DISPLAY PROGRAM 25

KEY IN CONTINGENCY
VHF RANGE RATE
PROGRAM (P25)
V37E 25E

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 25

RESET RENDEZVOUS
FLAG

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#10

#20

#30

HOLD
...
SNAP

050

#60

70

180

++
+01
+
+
+
+
+
+
+489
++

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

PROCEED .NEW
DATA

STORE NEW
DATA

CALCULATE TFO FOR
POSSIBLE DISPLAY IN
N76.

CALL VHF RANGE RATE
MARK PROCESSING
ROUTINE (R27)

IS NOUN 72 ZERO?

.NO .YES

++
+459
++

KEY IN V25E AND
LOAD NEW DATA.
NOTE: IF OPTIMIZA-
TION SEQUENCE AL-
READY ESTABLISHED,
CHANGE N72 ONLY WHEN
-02B25 <TFO <-01B35.

THE VHF RANGE RATE
MARK PROCESSING
ROUTINE IS NOW
RUNNING. RANGE AND
RANGE RATE DATA
ARE FROM VHF ONLY.
THEY ARE INDEPENDENT
OF THE STATE
VECTORS.
IF OPTIMIZATION IS
TO BE PERFORMED, A
NEW OPTIMIZATION
WILL OCCUR AUTOMA-
TICALLY EVERY 4 MIN
FOLLOWING THE FIRST.

#90

#100

#110

#120

#130

AND SEC TO NEAREST
SEC. THE VALUE IS
+59859 IF NO
OPTIMIZATION WAS
REQUESTED.

#180

#190

#200

#210

#220

DO I WANT TO ALTER
THE PRESENT OPTI-
MIZATION SEQUENCE?

.NO .YES

WHEN FINISHED
WITH DISPLAY
KEY IN PROCEED.
NOTE: NEXT
DISPLAY NOT
VALID UNTIL
TFO = +00802

WHEN FINISHED
WITH DISPLAY KEY
IN RECYCLE V32E

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF RECYCLE
OR PROCEED

.P
.R
.E
.C
.D
.Y
.C
.E
.L
.E
.D

FLASH VERB-NOUN TO
REQUEST RESPONSE. AND
DISPLAY RENDEZVOUS
PARAMETERS:

HOLD
MON

V16 N77
R1 - RANGE RATE
R2 - RANGE RATE
R3 - THETA/PHI/CODE

#230

RANGE - VHF RANGE
TO SKYLAB IN NAUTICAL
MILES TO NEAREST
.01 NM.

RANGE RATE - RANGE
RATE BETWEEN CSM AND
SKYLAB CALCULATED
AND OPTIMIZED TO N72
TIME BY VHF RANGE
RATE FILTER. IN FPS
TO NEAREST .1 FPS.
NEGATIVE SIGN INDICATES
CLOSING.

#240

THETA/PHI/CODE -
USED AS A CODE,
FIXED AT -00001
THROUGHOUT P25.

#250

NOTE: IF R27 OPT=0,
RANGE AND RANGE RATE
ARE CURRENT VALUES.
IF R27 OPT NOT 0:

++
+01

TFO < -01B35 RANGE,
RANGE RATE ARE
CURRENT VALUES;

#260

-01B35 < TFO <
+00B02 RANGE,
RANGE RATE FIXED
AT LAST CURRENT
VALUE;

+00B02 < TFO <
+01B35 RANGE,
RANGE RATE ARE
OPTIMIZING VALUES;

#270

TFO > +01B35 RANGE,
RANGE RATE ARE
CURRENT VALUES.

093

117
P25/SKYLARK

N72 TIME IS HERE
INCREMENTED BY 4
MIN, IFJ NOW COUNTS
DOWN FROM -32825 TO
NEXT OPT TIME.

++
+459
++

++
+01
++
+489
++

DO I WANT TO ALTER
THE PRESENT OPTIMI-
ZATION SEQUENCE?

.NO .YES

WAIT FOR KEYBOARD
ENTRY

WHEN FINISHED
WITH DISPLAY
KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF RECYCLE
OR PROCEED

.P
.R
.E
.C
.Y
.C
.L
.E
.D

WHEN FINISHED
WITH DISPLAY KEY
IN RECYCLE V32E

DO ROUTINE R00

DO ROUTINE R00

#280

#290

#300

#310

#320

P25/SKYLARK

• • • • •
• • • • •
• • • • •

EXIT
P25

REV 00 PCR 032, SKYLARK MEMDS #8, 19
REV 01 PCR 459, PCN 489

#330

094
P25/SKYLARK

CMC UPDATE PROGRAM (P27)

REV 01 03/20/72

PURPOSE:

(1) TO INSERT INFORMATION INTO THE CMC VIA THE DIGITAL JPLINK BY TRANSMISSION FROM THE GROUND OR VIA THE DSKY KEYBOARD BY CREW MANUAL INPUT.

ASSUMPTIONS:

(1) THE CMC MUST BE IN THE OPERATE CONDITION. THE IMU MAY BE IN STANDBY OR OPERATE CONDITION.

(2) CMC UPDATES ARE OF FOUR CATEGORIES:

(A) PROVIDE AN UPDATE FOR CMC LIFTOFF TIME (V70).

(B) PROVIDE AN UTCL INCREMENT FOR THE CMC CLOCK ONLY (V73).

(C) PROVIDE LOAD CAPABILITY FOR A BLOCK OF SEQUENTIAL ERASABLE LOCATIONS (1-18 INCLUSIVE LOCATIONS WHOSE ADDRESS IS SPECIFIED) (V71).

(D) PROVIDE LOAD CAPABILITY FOR 1-9 INCLUSIVE INDIVIDUALLY SPECIFIED ERASABLE LOCATIONS (V72).

(3) A COMPLETE DESCRIPTION OF THE CMC UPLINK FORMAT IS INCLUDED IN SECTION 2 OF R-693.

(4) UPDATE IS ALLOWED IN THE CSM WHEN THE CMC IS IN P00, P02, OR P20 (OPTIONS 1, 2, OR 5), AND IF THE DSKY IS AVAILABLE.

(5) THE UPTCL ACCEPT/BLOCK SWITCH MUST BE IN ACCEPT FOR TELEMETRY UPDATE.

(6) THE PROGRAM IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR BY THE GROUND BY JPLINK TRANSMISSION.

(7) THE AUTOMATIC MODE OF UPDATE IS PROGRAM SELECTION AND UPDATE VIA THE GROUND BY UPLINK TRANSMISSION. THE ONLY DIFFERENCE BETWEEN THIS AND MANUAL SELECTION BY THE ASTRONAUT IS THAT THE DSKY RESPONSES ARE KEYED IN BY THE ASTRONAUT RATHER THAN TRANSMITTED.

PROG
CONT

CMC	GROUND	CREW
NOTIFY CREW OF INTENTION TO UPDATE. SPEC- IFY PARAMETERS AND COORDINATE TIME.	VERIFY THAT UPDATE WILL BE SATISFACTORY W.R.T. TIME, WORK IN PROGRESS AND CMC ACTIVITY.	

#10

SELECT THE DE-
SIRED TYPE OF
UPDATE:
V70-LIFTOFF
TIME INCREMENT
V71-CONTIGUOUS
BLOCK UPDATE
V72-SCATTER
UPDATE
V73-JICIAL TIME
INCREMENT

#20

INTERRUPT PRESENT
PROGRAM AND TURN
ON UPLINK ACTY LITE

#30

..... TRANSMIT
V7XE

START CMC UPDATE
PROGRAM

#40

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

N Y

TURN ON OPERATOR
ERRJR LITE

#50

OBSERVE OPER-
ATOR ERROR
LITE ON, AND
UPLINK ACTY
LITE ON

#60

099

125
P27/SKYLARK

SELF MINIMUM INDEX
IS 3; MAXIMUM IS 20.

#160

WAIT FOR KEYBOARD
ENTRY

#170

TRANSMIT
TERMINATE
V34E

#180

GO TO "A"
BELOW

TRANSMIT
INDEX
VALUE

#190

TERMINATE FLASH UPON
RECEIPT OF TERMINATE
OR INDEX

.I
.N
.D
.E
.X
.I
.N
.A
.T
.E
...

#200

GO TO "A"
BELOW

DISPLAY
INDEX

P27/SKYLARK

#210

#220

#230

#240

#250

VALUE IN
R1 AS IT
IS LOADED

IS INDEX LESS THAN
3 OR GREATER THAN
20?

.Y .N
.
.
.
GO TO "J"
ABOVE

STORE INDEX
IN COMPNB

CALCULATE ADDRESS
FOR STORAGE OF NEXT
DATA LOAD

"C"
FROM
RELW

#260

#270

#280

062#

#300

P27/SKY LARK

#320

#330

05340

#350

THE TRANSMITTED
WORDS WILL BE
CORRECTED.

DO I WISH TO
TERMINATE?

WAIT FOR KEYBOARD
ENTRY

#360

DO I WISH
TO COR-
RECT ANY
DATA?

#370

TRANSMIT
TERMIN-
ATE V34E

#380

GO TO
"A"
BELOW

#390

TRANSMIT
OCTAL
IDENTIF-
IER

#400

TRANSMIT
PROCEED
V33E

RECEIVED

IS THIS AN OCTAL
TIME INCREMENT
(V73)?

.Y .N
.
.
.
.
.

WOULD THE INCRE-
MENT CAUSE THE
CMC CLOCK TO
OVERFLOW?

.Y .N
.
.

TURN ON
OPERATOR
ERROR LITE

MONITOR DSKY:
OBSERVE OPER-
ATOR ERROR
LITE

GO TO "A"
BELOW

GO TO "A"
BELOW

GO TO "A"
BELOW

IS ORBITAL INTEGRA-
TION IN PROGRESS?

.Y .N
.
.
.
.

#460

#470

#480

#490

#500

#510

• • • •

$$\begin{matrix} z & & & \\ \bullet & \bullet & \bullet & \\ & & & \\ y & & & \\ \bullet & \bullet & \bullet & \end{matrix}$$

z

• • • • •

• • • • •

• • •

MONITOR DSKY:
OBSERVE OPERA-
TOR ERROR LITE

.....

.....

.....

.....

107

133
P27/SKYLARK

GO TO "A"
BELOW

GO TO "A"
BELOW

#560

#570

#580

#590

#600

#610

P27/SKYLARK

GO TO "A"
BELOW

TRANSFER DATA TO
SPECIFIED BLOCK
(V71) OR SPECIFIED
ADDRESSES (V72)

WAS THIS A STATE
VECTOR UPDATE?

.N .Y

"A"
FROM
ABOVE
ZERO
CHANNEL
77

"A"
FROM
ABOVE

TURN OFF UPLINK ACTY-
LITE

MONITOR DOWN-
LINK:

OBSERVE UPLINK
ACTY LITE
OUT, REVERSION
TO ORIGINAL
DOWNLINK LIST,
TERMINATION OF
P27, AND RE-
TURN TO P00,
P02, OR P20.

TERMINATE P27 AND GO
TO PROGRAM WHICH WAS

"A"
FROM
ABOVE

MONITOR DSKY:
SUCCESSFUL UPDATE IS
INDICATED BY UPLINK
ACTY LITE OUT,
OPERATOR ERROR LITE
OUT, AND RETURN TO
P00, P02, OR P20.

#620

#630

#640

#650

REV 00 05/19/71

TIME OF LONGITUDE PROGRAM (P29)

PURPOSE:

(1) TO PROVIDE THE ASTRONAUT ESTIMATED TIME OF PASSAGE OVER A SELECTED LONGITUDE.

ASSUMPTIONS:

(1) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(2) THIS PROGRAM MAY BE SELECTED TO FIND THE TIME OF LONGITUDE OF EITHER THE OWS OR CSM.

(3) THIS PROGRAM ASSUMES THE VEHICLE WHOSE GROUND TRACK PARAMETERS ARE CALCULATED TO REMAIN IN FREE FALL FROM THE SELECTED START TIME UNTIL TIME OF LONGITUDE CROSSING.

PROG
CONT

CMC

GROUND

CREW

.CREW
.PROGRAM
.SELECTION
. . .
. . .

DO R00 TO START
TIME OF LONGITUDE
PROGRAM (P29).
DISPLAY PROGRAM 29

KEY IN TIME OF LONG-
ITUDE PROGRAM (P29)
V37E29E

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 29

"A"

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#10

#20

#30

#40

#50

#60

#70

112

P29/SKYLARK

SET TRACK FLAG

SET CMC ASSUMED
OPTION TO 00001.

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OPTION CODE
FOR ASSUMED VEHICLE
(OMS OR CSM)

V04 N06
R1 00002
R2 0000X
R3 BLANK

R1 IS THE OPTION
CODE FOR ASSUMED
VEHICLE.

R2 IS THE CMC
ASSUMED OPTION:
00001 - THIS
VEHICLE
00002 - OTHER
VEHICLE

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED VEHICLE
(OMS OR CSM)

IS THE ASSUMED
OPTION CORRECT?

.Y .N

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED

08*

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

```

.P
.R
.O
.C
.E
.E
.D

```

KEY IN V22E
AND LOAD THE
DESIRED OPTION
INTO R2

068

ZERO BASE TIME
DISPLAY REGIS-
TERS. R1, R2,
AND R3 WILL
INITIALLY READ
0000.

#110

HOLD
- - -
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY BASE TIME:
V06 N34

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

#120

R1-BASE TIME-HRS
R2-BASE TIME-MINS
R3-BASE TIME-SECS

BASE TIME- TIME FROM
WHICH THE NEXT
CROSSING OF DESIRED
LONGITUDE IS
COMPUTED.
IN HRS, MINS, SECS
TO NEAREST .01 SEC.

OF BASE TIME

#130

#140

#150

#160

#170

DO I WISH TO HAVE
THE CMC COMPUTE
PARAMETERS FOR THE
PRESENT TIME?

.N .Y

AM I SATISFIED
WITH THE DIS-
PLAYED TIME?

.N .Y

ARE ALL
THREE RE-
GISTERS
EQUAL TO
ZERO?

.Y .N

KEY IN
PROCEED

WAIT FOR KEYBOARD
ENTRY

R2 - LONG
R3 - BLANK
LONG - DESIRED LONG-
ITUDE OF VEHICLE.
+ IS EAST. IN
DEGREES TO NEAREST
.01 DEGREE.

#230

TUDE

AM I SATISFIED WITH
THE DISPLAYED
LONGITUDE?

#240

.Y .N

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED

#250

TERMINATE FLASH UPON
RECEIPT OF NEW DATA
OR PROCEED

KEY IN V22E AND
LOAD NEW DATA.

#260

.NEW .P
.DATA .R
. .O
STORE .C
NEW DATA .E
. .E
. .D

#270

COMPUTE TIME TO NEXT
CROSSING OF DESIRED

LONGITUDE AFTER BASE
TIME.

.

HOLD .
.....
SNAP .
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY T LAT LONG:
V06 N34
R1-T LAT LONG-HRS
R2-T LAT LONG-MINS
R3-T LAT LONG-SECS

T LAT LONG- TIME OF
LONGITUDE CROSSING.
IN HRS, MINS, SECS
TO NEAREST .01 SEC.

.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH
UPON RECEIPT OF
RECYCLE OR PROCEED

.P
.R
.E
.D
.C
.Y
.C
.C
.E
.L
.D

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF T LAT LONG.

.

DO I WISH TO OBTAIN
NEW PARAMETERS USING
THE ORIGINAL BASE
TIME AND A NEW
DESIRED LONGITUDE?

.N
.Y
.

WHEN FINISHED
WITH DISPLAY,
KEY IN PROCEED

WHEN FINISHED
WITH DISPLAY,
KEY IN RECYCLE
V32E

.

REV 00 05/19/71

EXTERNAL DELTA V PROGRAM (P30)

PURPOSE:

(1) TO ACCEPT TARGETING PARAMETERS OBTAINED FROM A SOURCE (S) EXTERNAL TO THE CMC AND COMPUTE THEREFROM THE REQUIRED VELOCITY AND OTHER INITIAL CONDITIONS REQUIRED BY THE CMC FOR EXECUTION OF THE DESIRED MANEUVER. THE TARGETING PARAMETERS INSERTED INTO THE CMC ARE THE TIME OF IGNITION (TIG) AND THE IMPULSIVE DELTA V ALONG CSM LOCAL VERTICAL AXES AT TIG.

(2) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN SPECIFIC DEPENDENT VARIABLES ASSOCIATED WITH THE DESIRED MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

- ASSUMPTIONS:
- (1) THE TARGET PARAMETERS (TIG AND DELTA V(LV)) MAY HAVE BEEN LOADED FROM THE GROUND DURING A PRIOR EXECUTION OF P27.
 - (2) THE EXTERNAL DELTA V FLAG IS SET DURING THIS PROGRAM TO DESIGNATE TO THE THRUSTING PROGRAM THAT EXTERNAL DELTA V STEERING IS TO BE USED.
 - (3) THE ISS NEED NOT BE ON TO COMPLETE THIS PROGRAM.
 - (4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW

• CREW PROG.
• SELECTION
•
•
•
•

DO R00 TO START
EXTERNAL DELTA V
PROGRAM (P30)
DISPLAY PROGRAM 30

KEY IN EXTERNAL
DELTA V PROGRAM
(P30)
V37E 30E

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 30

#10

#20

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80

• • •
• • •
• • •
• • •
• • •
• • •

060

COMPONENT OF
IMPULSIVE DELTA V AT
TIG ALONG VXR, IN FPS
TO NEAREST .1 FPS.

AM I SATISFIED WITH THESE VALUES?

z

#110

DELTA VL (LV):
COMPONENT OF
IMPULSIVE DELTA V AT
TIG ALONG -R. IN FPS
TO NEAREST .1 FPS

WHERE R IS CSM GEO-
CENTRIC RADIUS
VECTOR AND V IS CSM
INERTIAL VELOCITY
VECTOR AT TIG.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P .NEW
.R .DATA
.O .
.C .
.E .
.E STORE NEW DATA
.D .

SET EXTERNAL
DELTA V FLAG

RESET UPDATE FLAG
(SEE P20)

#120

#130

#140

#150

#160

#170

KEY IN
PROCEED

KEY IN V25E AND
LOAD THE DESIRED
COMPONENTS OF
DELTA V

BASED ON THE STORED
TARGET PARAMETERS
COMPUTE NECESSARY
DEPENDENT VARIABLES
FOR EVALUATION OF THE
THRUSTING MANEUVER
INCLUDING PERIGEE
ALTITUDE, APOGEE
ALTITUDE AND DELTA V
REQUIRED (SEE SECTION 5.3 OF R693)

#180

HCLD

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CALCULATED
THRUSTING PARAMETERS:
V06 N42
R1-APO ALT
R2-PER ALT
R3-DELTA V

PO ALT - ALTITUDE
OF APOGEE ABOVE THE
LAUNCH PAD RADIUS
IN NAUTICAL MILES TO
THE NEAREST .1 NM.

PER ALT - ALTITUDE
OF PERIGEE ABOVE THE
LAUNCH PAD RADIUS
IN NAUTICAL MILES
TO THE NEAREST
.1 NM.

DELTA V - MAGNITUDE
OF IMPULSIVE DELTA V
VECTOR AT TIG. IN FPS
TO NEAREST .1 FPS

NOTE: IF APO ALT OR
PER ALT EXCEEDS
SCALE, THE DISPLAY
WILL BE 9999.9 NM

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF CALCULATED
THRUSTING PARAMETERS

- IS A GROUND STATION
- AVAILABLE FOR CON-
- FIRMATION OF THESE
- PARAMETERS?

• • •

#220

#230

MONITOR CMC
DOWNLINK TELE-
METRY OF APO
ALT, PER ALT
AND DELTA V RE-
QUIRED. COORDI-
NATE EVALUATION
OF CMC COMPUTED
PARAMETERS WITH
ASTRONAJT

COORDINATE
EVALUATION OF
THE CMC COMPU-
TED PARAMETERS
WITH THE
GROUND

#240

SELECT ONE OF THE
FOLLOWING FIVE
ALTERNATIVES:

#250

(1) IF THE CALCU-
LATED DATA IS
SATISFACTORY,
PERFORM THE THRU-
STING MANEUVER
USING THE CMC
CALCULATED PARA-
METERS WITHOUT
GROUND CONFIRMA-
TION.

#260

(2) IF THE CALCJ-
LATED DATA IS NOT
SATISFACTORY AD-
JUST THE CALCULA-
TED PARAMETERS BY
RESELECTING P30
AS NECESSARY AND
CHANGING THE
LOADED AIM PARA-
METERS UNTIL CMC
COMPUTED PARAMET-
ERS ARE SATISFAC-
TORY. THEN
PERFORM THE THRJ-
STING MANEUVER.
(3) REMAIN AT

#270

THIS POINT IN THE
CMC PROGRAM UNTIL
GROUND COORDINA-
TION IS AVAIL-
ABLE.
(4) SELECT A NEW
PROGRAM AS DE-
SIRED UNTIL
GROUND CO-ORDINA-
TION IS AVAILABLE
THEN RESELECT
P30. LEAVE AIM
PARAMETERS
UNCHANGED ETC.
(5) SELECT A NEW
PROGRAM AS DE-
SIRED AND PERFORM
THRUSTING MANEU-
VER USING BACKUP
PROCEDURE.

#290

3 2.1.
4.
5.

#300

ARE THESE
PARAMETERS
SATISFACTORY
FOR USE BY THE
CMC FOR THE
THRUSTING
MANEUVER?

N Y.
.
.
.
.....

#310

SELECT ONE OF
THE FOLLOWING
FOUR ALTERNA-
TIVES:

#320

#330

#340

#350

#360

(1) ADJUST THE
CALCULATED PARA-
METERS BY RESEL-
ECTING P30 AS
NECESSARY AND
CHANGING THE
LOADED AIM PARA-
METERS UNTIL CMC
COMPUTED PARA-
METERS ARE
SATISFACTORY.
(2) OBTAIN NEW
AIM PARAMETERS
FROM THE GROUND
BY VOICE LINK,
RESELECT P30,
KEY IN NEW DATA,
ETC.
(3) SELECT THE
CMC UPDATE
PROGRAM (P27).
LOAD NEW AIM
PARAMETERS FROM
THE GROUND VIA
THE CMC UPLINK,
OR BY CREW
DSKY INPUT.
OBSERVE NEW AIM
PARAMETERS, ETC.
(4) TERMINATE
P30 BY SELECT-
ING A NEW PRO-
GRAM AS DESIRED
AND PERFORM THR-
USTING MANEUVER
USING BACKUP
PROCEDURES.

- 1.
- 2.
- 3.
- 4.

WAIT FOR KEYBOARD
ENTRY.

KEY IN PROGRAM
SELECTION AS
DESIRED
V37E--E

0263

#380

#390

00400

0178

#420

P30/SKYLARK

#430

0440

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF MARK CTRS, TFI,
AND MGA

MARK CTRS - THE NUMBER OF MARKS PROCESSED BY THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE THE LAST W-MATRIX REINITIALIZATION (REFER TO ASSUMPTION (8) OF P20). THE REGISTER WILL DISPLAY XX8XX WHERE THE TWO MOST

#460

131

157
P30/SKYLARK

SIGNIFICANT DIGITS
IS THE VHF RANGING
MARK COUNTER AND
THE TWO LEAST SIGNI-
FICANT DIGITS IS THE
OPTICS MARK COUNTER.

NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACKUP AND
PRIMARY MARKS.

#470

TFI - TIME FROM
TIG. IN MIN AND SEC
TO NEAREST SEC.
MAXIMUM READING IS
59859. (- BEFORE
+ AFTER TIG.)

MGA-MIDDLE GIMBAL
ANGLE AT TIG IF
+X CSM AXIS IS
ALIGNED WITH INITIAL
THRUST DIRECTION.
SIGN IS ALWAYS +
EXCEPT WHEN THE IMU
IS NOT ALIGNED THE
VALUE IS -00002. IN
DEGREES TO NEAREST
.01 DEGREE

#490

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED

.PRO

#510

P30/SKYLARK

NCL TARGETING PROGRAM (P31)

REV 01 03/20/72

PURPOSE:

- (1) TO CALCULATE THE PARAMETERS ASSOCIATED WITH THE NCL MANEUVER FOR DELTA V BURNS.
- (2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE CMC BY THE ASTRONAUT.
- (3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NCL MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.
- (4) TO STORE THE NCL TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS:

- (1) AT A SELECTED TPI TIME, THE LINE OF SIGHT BETWEEN THE CSM AND THE OWS IS SELECTED TO BE A PRESCRIBED ANGLE (E) FROM THE HORIZONTAL PLANE DEFINED AT THE ACTIVE POSITION.
- (2) THE NCL, NC2, VCC MANEUVERS ARE CONSTRAINED TO BE HORIZONTAL MANEUVERS.
- (3) THE NSR MANEUVER IS CONSTRAINED TO RESULT IN COELLIPTIC ORBITS FOLLOWING THE MANEUVER.
- (4) THE FOLLOWING TIME CONSTRAINTS APPLY:
 - A) THE TPI TIME AND THE TIME BETWEEN THE NCC AND NSR MANEUVERS ARE SPECIFIED (DSKY INPUT AND PAD-LOAD RESPECTIVELY).
 - B) THE TIMES BETWEEN THE NCL AND NC2 MANEUVERS AND THE NC2 AND VCC MANEUVERS ARE INDIRECTLY SPECIFIED BY SPECIFYING THE NUMBER OF 1/2 REVOLUTIONS INVOLVED IN THE TRANSFERS BETWEEN THE MANEUVERS (DSKY INPUT AND PAD-LOAD RESPECTIVELY).
- (5) THE ALTITUDES BETWEEN THE OWS ORBIT AND THE CSM AT BOTH NCC AND NSR TIME ARE SPECIFIED (DSKY INPUT).
- (6) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE NORMALLY LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME EXCEPT FOR CONCENTRIC FLIGHT PLAN MANEUVER SEQUENCES.
- (7) IF P20 IS IN OPERATION WHILE THE PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.
- (8) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.
- (9) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

PROG

CMC

GROUND

CREW

CONT

•AUTOMATIC
•PROGRAM
•SELECTION
.
.
...

•CREW
•PROGRAM
•SELECTION
.
.
...

DO R00 TO START
NCL TARGETING
PROGRAM (P31)

KEY IN NCL TARGET-
ING PROGRAM (P31)
V37E31E

#10

DISPLAY P31

MONITOR DSKY:
OBSERVE DISPLAY
OF P31

#20

•
•
• "START"
•
•
•
•
•
•
•
•

#30

SET UPDATE FLAG

SET TRACK FLAG

#40

RESET PCFLAG

#50

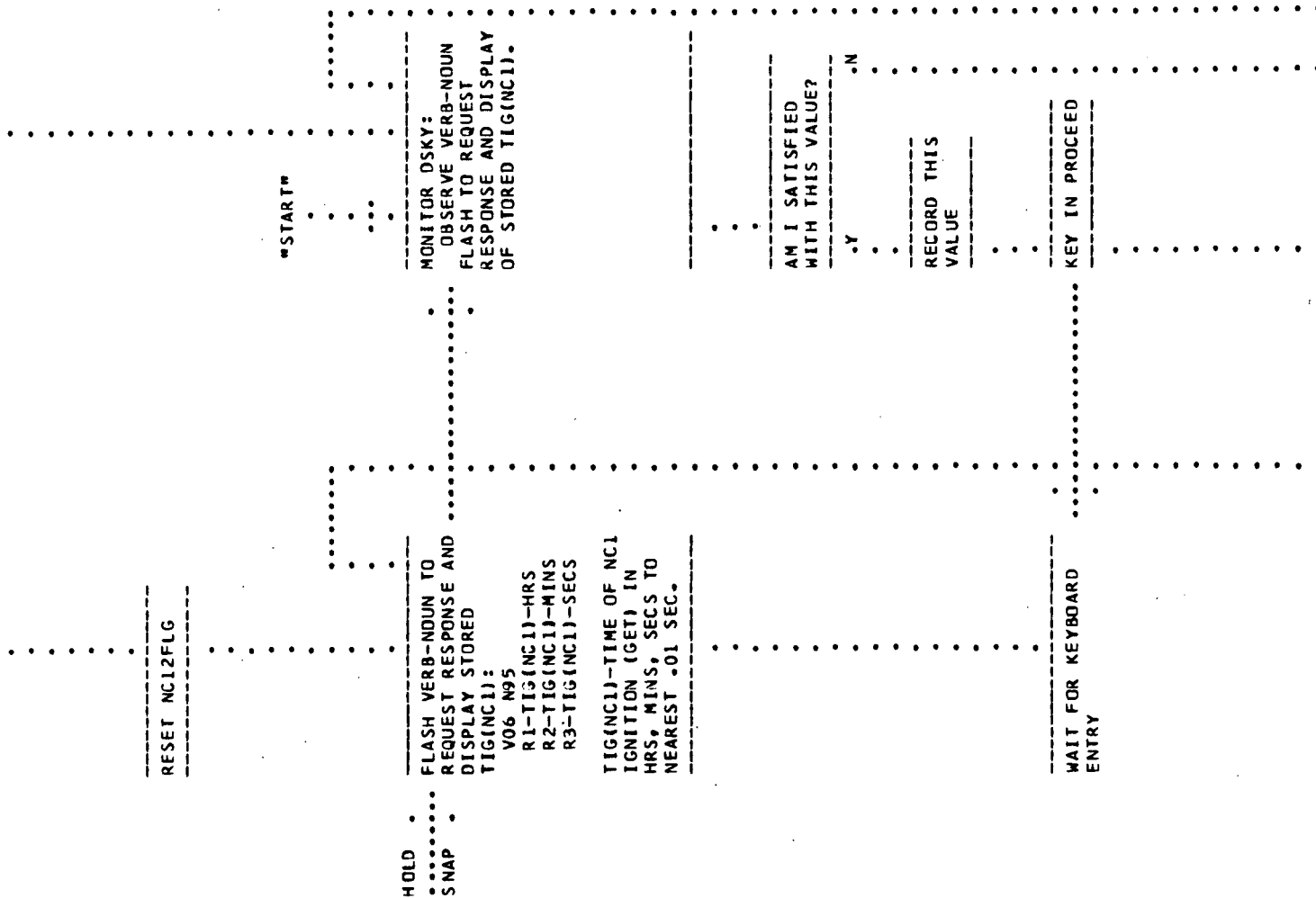
#60

#70

#80

#90

#100



TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

PRO
NEW
DATA

STORE DATA

KEY IN V25E
AND LOAD DE-
SIRE VALUE

#110

HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED HALF-
REVS, DELTA H(NCC),
AND DELTA H(NSR)
V06 V57
R1 - HALFREVS
R2 - DELTA H(NCC)
R3 - DELTA H(NSR)

#120

MONITOR DSKY:

OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED HALFREVS,
DELTA H(NCC) AND
DELTA H(NSR)

#130

HALFREVS - NUMBER OF
1/2 REVS BETWEEN NC1
AND NC2

AM I SATISFIED WITH
THESE VALUES?

DELTA H(NCC) - THE
ALTITUDE BETWEEN THE
ACTIVE AND PASSIVE
VEHICLE ORBITS AT
TIG(NCC). SIGN IS +
WHEN THE ACTIVE
VEHICLE IS BELOW THE
PASSIVE VEHICLE. IN
NAUTICAL MILES TO
NEAREST 0.1 NM.

Y N

#140

DELTA H(NSR) - THE
ALTITUDE BETWEEN THE
ACTIVE AND PASSIVE

RECORD THESE
VALUES

#150

VEHICLE ORBITS AT
TIG(NSR). SIGN IS +
WHEN THE ACTIVE
VEHICLE IS BELOW THE
PASSIVE VEHICLE. IN
NAUTICAL MILES TO
NEAREST 0.1 NM.

#160

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

PRO
NEW
DATA

#170

KEY IN V25E
AND LOAD DE-
SIRED VALUES

STORE DATA

#180

HOLD

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED
TIG(TPI):

V06 N37
R1-TIG(TPI)-HRS
R2-TIG(TPI)-MINS
R3-TIG(TPI)-SECS

#190

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED TIG(TPI)

#200

TIG(TPI)-TIME OF TPI
IGNITION (GET). IN
HRS, MINS, SECS, TO
NEAREST .01 SEC.

AM I SATISFIED WITH
THIS VALUE?

.Y .N

RECORD THIS
VALUE

#210

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

#220

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V25E
AND LOAD THE
DESIRED VALUE

.PRO .NEW
.DATA

STORE DATA

#230

GO TO
"B"
BELOW

#240

RESET FINAL
FLAG

"A"

GO TO

"B"
BELOW

#250

BASED ON THE STORED
TARGET PARAMETERS,
COMPUTE AND STORE
THE FOLLOWING

PARAMETERS:

TIG(NC2) IN N28

TIG(NCC) IN N11

TIG(NSR) IN N13

DELTA VILV) FOR NC1

IN N81

DELTA VINC2) IN R1

N84

DELTA HINC2) IN R2

N84

DELTA VINCC) IN R3

N84

DELTA VILV) FOR NSR

IN N82

ESTABLISH ALARM IF:

(A) FAILURE IN THE

PHASE WATCH

ITERATION.

(ALARM CODE

00600).

(B) FAILURE IN EITHER

THE NC2 OR NCC

HEIGHT MANEUVER

ITERATIONS

(ALARM CODE

00601).

(C) FAILURE IN THE

OUTER (PHASE)

LOOP ITERATION

(ALARM CODE

00602).

(D) FAILURE IN THE

QRDTPI ITERATION

(ALARM CODE

++
+01

#260

+

+

+

+

+

+489

++

#270

#280

#290

006031.

NO	ALARM	ALARM
•	•	•
•	•	•
•	•	•
•	•	•

IS THIS ALARM
00502?

y . . .

y . . .

IS FINAL FLAG
SET?

$$\begin{aligned} & \gamma \dots \\ & z \dots \end{aligned}$$

SET UPDATE
FLAG

POSS
HOLD
- - -
SNAP

FLASH VERB-NOUN
TO REQUEST
RESPONSE AND
DISPLAY ALARM

DE: V05 N09
R1-
R2-
R3-

THE EXPECTED
ALARM CODES AT
THIS TIME ARE
00500, 00601,
00602, AND

• • • • •

MONITOR DSKY:
DOES ALARM CODE
INDICATE COMPUTA-
TIONAL DIFFICULTY?

Y
Z

DO I WISH
HSIM I OCT
231111Z

2.

140

00603.

WAIT FOR KEY-
BOARD ENTRY

KEY IN
PROCEED

TERMINATE FLASH
UPON RECEIPT OF
RECYCLE OR
PROCEED

.PRD .V32E

IS THIS
ALARM RETURN
00602? TO
"START"

Y . N

.600
.601
.603

IS FINAL FLAG SET?

.Y . N

SET
N81=0

KEY IN RECYCLE
V32E
RETURN TO
START OF
PROGRAM AND
ADJUST INPUT
PARAMETERS.

RETURN
TO
"START"

IS THIS
ALARM
00602?

N . Y

.600
.601
.603

#350

#360

#370

#380

#390

P31/SKYLARK

TERMINATE FLASH UPON
RECEIPT OF PROCEED

.PRO

#450

HOLD

SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CALCULATED
COMPONENTS OF DELTA
V(LV) FOR NC1:

V06 V81

R1-DELTA VX(LV)

R2-DELTA VY(LV)

R3-DELTA VZ(LV)

DELTA VX(LV) - COM-
PONENT OF IMPULSIVE
DELTA V AT TIG(NC1)
ALONG (RXV)XR. IN
FPS TO NEAREST .1
FPS.

DELTA VY(LV) - COM-
PONENT OF IMPULSIVE
DELTA V AT TIG(NC1)
ALONG VXR. IN FPS TO
NEAREST .1 FPS.

DELTA VZ(LV) - COM-
PONENT OF IMPULSIVE
DELTA V AT TIG(NC1)
ALONG -R. IN FPS TO

MONITOR DSKY:

OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF DELTA V(LV) FOR
NC1

NOTE: N81 VALUES

WILL BE ZERO IF PRO

WAS KEYED AFTER

ALARM 600.601 OR 603

AM I SATISFIED WITH
THESE VALUES?

.Y .N

RECORD THESE
VALUES

#490

#500

#510

#520

#530

#540

144

NEAREST .1 FPS.

WHERE R IS CSM GEO-
CENTRIC RADIUS
VECTOR AND V IS CSM
INERTIAL VELOCITY
VECTOR AT TIG(NCI)

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

KEY IN V25E
AND LOAD DE-
STORED VALUES

.PRO
.NEW
.DATA

STORE DATA

SET EXTERNAL DELTA V
FLAG

"B"

IS FINAL FLAG SET?

.N .Y

#550

#560

#570

085#

#590

P31/SKYLARK

V16 N45
R1-MARK COUNTERS
R2-TFI
R3-MGA

MARK COUNTERS - THE
NUMBER OF MARKS PRO-
CESSED BY THE REN-
DEZVOUS TRACKING
DATA PROCESSING
ROUTINE (R22)
SINCE THE LAST
W-MATRIX REINITIALI-
ZATION (REFER TO
ASSUMPTION 18) OF
P20). THE REGISTER
WILL DISPLAY XX8XX
WHERE THE TWO MOST
SIGNIFICANT DIGITS
COMPRISE THE VHF
RANGING MARK COUNTER
AND THE TWO LEAST
SIGNIFICANT DIGITS
COMPRISE THE OPTICS
MARK COUNTER.
(NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH
BETWEEN BACKUP AND
PRIMARY MARKS.)

TFI-TIME FROM
TIG(1). IN MIN AND
SEC TO NEAREST SEC.
MAX READING IS 59859
SIGN IS - BEFORE, +
AFTER TIG(1).

MGA-MIDDLE GIMBAL
ANGLE AT TIG(1) IF
CSM +X AXIS IS
ALIGNED WITH INITIAL
THRUST DIRECTION. IN
DEGREES TO THE
NEAREST .01 DEGREE.
SIGN IS ALWAYS +
EXCEPT:

(A) WHEN DISPLAYED

TFI AND MGA

.....

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

Y N
.....
DO I WISH TO
TERMINATE THE

.....

#600

#610

#620

#630

AT ANY TIME
OTHER THAN THE
LAST PASS
THROUGH THE
PROGRAM THE
VALUE IS
-0001.

(B) ON THE LAST
PASS WHEN THE
TMU IS NOT
ALIGNED THE
VALUE IS
-0002.

WAIT FOR KEYBOARD
ENTRY

MARK PROCESS
AND DO THE
FINAL PASS
THROUGH THE
PROGRAM?

.Y .N

KEY IN
PROCEED

KEY IN
PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

.PROCEED .RECYCLE

RESET UPDATE
FLAG

KEY IN RECYCLE
V32E

GO TO
"A"
ABOVE

#640

#650

#660

#670

#680

069

002#

#710

0720

#730

148

P31/SKYLARK

CHANGE W-MATRIX
REINITIALIZA-
TION VALUES TO
2000 F, 2 FPS

042#

#750

#760

CHANGE CONTROL VOTES

REV 00 PCR 042,448, PCN 411, SL MEMD #2
REV 01 PCN 489

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NC2 TARGETING PROGRAM (P32)

REV 01 03/20/72

PURPOSE:

- (1) TO CALCULATE PARAMETERS ASSOCIATED WITH THE NC2 MANEUVER FOR DE-TA V BURNS.
- (2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE CMC BY THE ASTRONAUT.
- (3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NC2 MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.
- (4) TO STORE THE NC2 TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS:

- (1) AT A SELECTED TPI TIME, THE LINE OF SIGHT BETWEEN THE CSM AND THE OMS IS SELECTED TO BE A PRESCRIBED ANGLE (E) FROM THE HORIZONTAL PLANE DEFINED AT THE ACTIVE POSITION.
- (2) THE NC2 AND NCC MANEUVERS ARE CONSTRAINED TO BE HORIZONTAL MANEUVERS.
- (3) THE NSR MANEUVER IS CONSTRAINED TO RESULT IN COELLIPTIC ORBITS FOLLOWING THE MANEUVER.
- (4) THE FOLLOWING TIME CONSTRAINTS APPLY:
 - A) THE TPI TIME AND THE TIME BETWEEN THE NCC AND NSR MANEUVERS ARE SPECIFIED (DSKY INPUT AND PAD-LOAD RESPECTIVELY).
 - B) THE TIME BETWEEN THE NC2 AND NCC MANEUVERS IS INDIRECTLY SPECIFIED BY SPECIFYING THE NUMBER OF REVOLUTIONS INVOLVED IN THE TRANSFER BETWEEN THE MANEUVERS (PAD-LOAD).
- (5) THE ALTITUDE BETWEEN THE OMS ORBIT AND THE CSM AT NSR IS SPECIFIED (DSKY INPUT).
- (6) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE NORMALLY LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME EXCEPT FOR CONCENTRIC FLIGHT PLAN MANEUVER SEQUENCES.
- (7) IF P20 IS IN OPERATION WHILE THE PROGRAM IS OPERATING THE ASTROVAJT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.
- (8) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.
- (9) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

++
+01
+
+489
++

PRGG

CMC

GROUND

CREW

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CONT

•AUTOMATIC
•PROGRAM
•SELECTION
.
.
...

•CREW
•PROGRAM
•SELECTION
.
.
...

DC R00 TO START
NC2 TARGETING
PROGRAM (P32)
DISPLAY P32

KEY IN NC2 TARGET-
ING PROGRAM (P32)
V37E 32E

#10

#20

#30

#40

MONITOR DSKY:
OBSERVE DISPLAY OF
P32

"START"

SET UPDATE FLAG

SET TRACK FLAG

CS#

၂၅၈

017

08*

06 芳

P32/SIKYLARK

#100

110

#120

#130

#240

: 154 P32/SKYLARK

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED,
OR NEW DATA.

NEW DATA

STORE DATA

```

HOLD      .      FLASH VERB-NOUN TO
.....      REQUEST RESPONSE AND
SNAP      .      DISPLAY STORED DELTA
              H(NGC) AND DELTA
              H(NSR)
              V06 N57
              R1-BLANK
              R2-DELTA H(NGC)
              R3-DELTA H(NSR)

```

DELTA H(NCC)--THE ALTITUDE BETWEEN THE ACTIVE AND PASSIVE VEHICLE ORBITS AT

MONITOR DSKY:
OBSERVE VERB--NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED DELTA
H(INCC) AND DELTA
H(NSR)

AM I SATISFIED WITH
THESE VALUES?

Y. Z.

TIG(INCJ). SIGN IS +
WHEN THE ACTIVE
VEHICLE IS BELOW THE
PASSIVE VEHICLE. IN
NAUTICAL MILES TO
NEAREST 0.1 NM

DELTA H(NSR)-THE
ALTITUDE BETWEEN THE
ACTIVE AND PASSIVE
VEHICLE ORBITS AT
TIG(NSR). SIGN IS +
WHEN THE ACTIVE
VEHICLE IS BELOW THE
PASSIVE VEHICLE. IN
NAUTICAL MILES TO
NEAREST 0.1 NM

RECORD THESE
VALUES

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED,
OR NEW DATA.

.P .NEW
.R .DATA
.D .
.C .
.E .
.D .
STORE DATA

LOAD THE DESIRED
VALUES

STORE DATA

#150

#160

#170

#180

#190

002#

#210

220

0324

1240

#250

#260

#270

#280

#290

.

RESET FINAL
FLAG
-----. . .
GO TO
"B"
BELOW"A"
.
.
...-----
BASED ON THE STO-
RED TARGET PARA-
METERS, COMPUTE
AND STORE THE
FOLLOWING PARA-
METERS:
TIG(NCC) IN N11
TIG(NSR) IN N13
DELTA V(LV) FOR
NC2 IN N81
DELTA V(NCC)
IN R1 OF N84
DELTA V(NSR) RSS
IN R3 OF N84
DELTA V(LV) FOR
NSR IN N82
ESTABLISH ALARM
IF:(A) FAILURE IN
THE PHASE MATCH
ITERATION.
(ALARM CODE
00600)(B) FAILURE IN
NCC HEIGHT MAN-
EUVER ITERATION++
+01
+
+489
++

(D) FAILURE IN
THE QROTPI
ITERATION
(ALARM CODE
OC603)

IS THIS ALARM
00602?

IS FINAL FLAG
SET?

SET UPDATE
FLAG

"An

• • • • •

POSS
HOLD
.....
SNAP

FLASH VERB-
NOUN TO RE-
QUEST RESPON-
SE AND DIS-
PLAY ALARM
CODE:
V05 N09
R1-
R2-
R3-

THE EXPECTED
ALARM CODES
AT THIS TIME
ARE 00600,
00601, 00602
AND 00603.

WAIT FOR
KEYBOARD
ENTRY

TERMINATE
FLASH UPON
RECEIPT OF
RECYCLE OR
PROCEED

P
R
E

MONITOR DSKY:
DOES ALARM CODE
DISPLAY INDICATE
COMPUTATIONAL
DIFFICULTY?

Y N

DO I WISH TO
CONTINUE?

N Y

KEY IN PROCEED

RETURN TO
START OF PRO-
GRAM AND
ADJUST INPUT
PARAMETERS.
KEY IN RECYCLE
V32E.

#350

#360

#370

#380

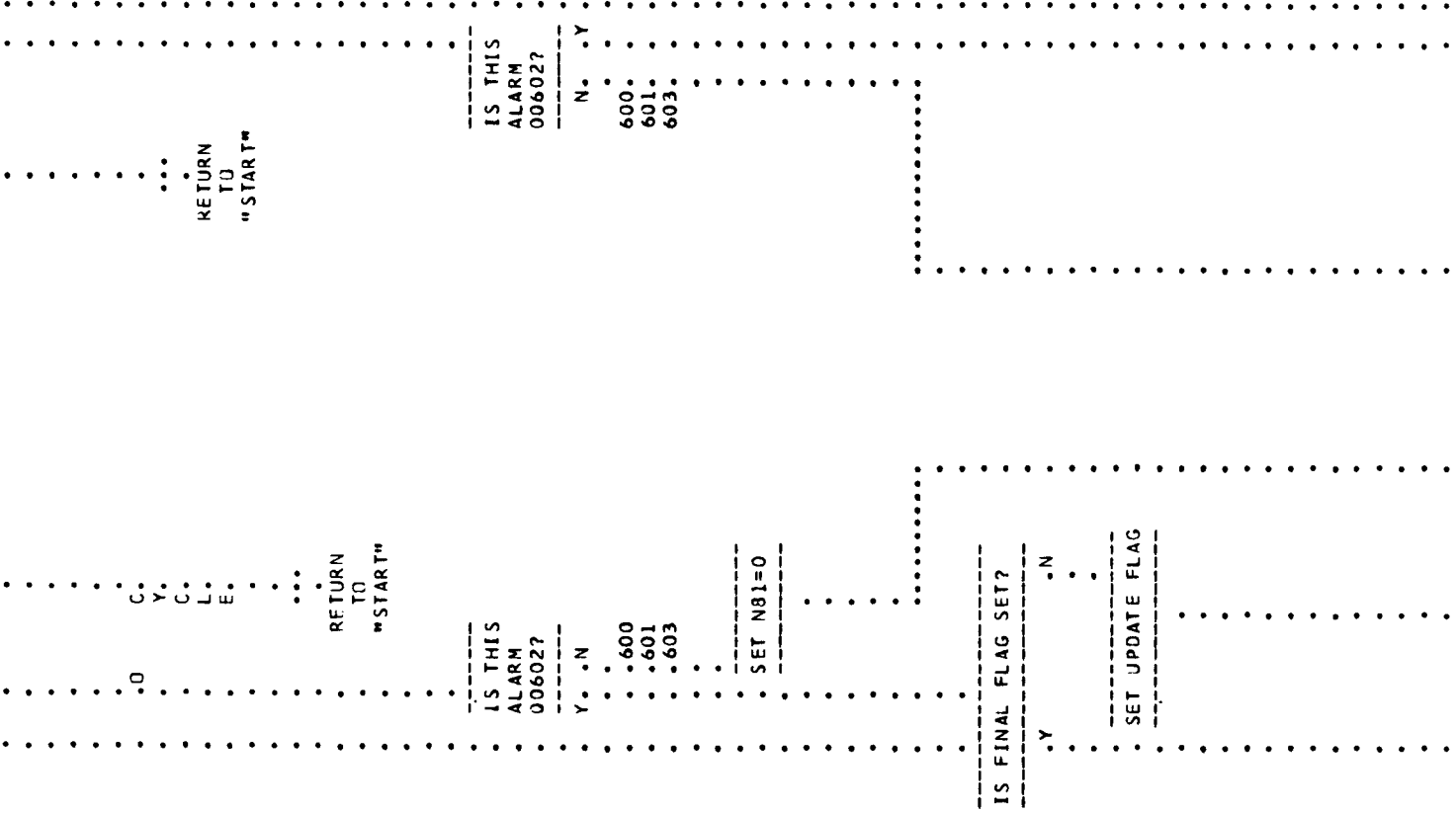
#390

#400

#410

#420

#430



IS AVAILABLE BY
KEYING IN V06N13.

#490

RECORD THESE
VALUES

#500

WAIT FOR KEYBOARD
ENTRY

#510

TERMINATE FLASH
UPON RECEIPT OF
PROCEED

KEY IN PROCEED

#520

.P
.R
.O
.C
.E
.E
.D

#530

FLASH VERB-NOUN
TO REQUEST RES-
PONSE AND DISPLAY
CALCULATED COM-

MONITOR DSKY:
OBSERVE VERB-
NOUN FLASH TO RE-
QUEST RESPONSE

HOLD
.....
SNAP

PONENTS OF DELTA
V(LV) FOR NC2:

V06 N81
R1-DELTA VX(LV)
R2-DELTA VY(LV)
R3-DELTA VZ(LV)

DELTA VX(LV) -
COMPONENT OF IM-
PULSIVE DELTA V
AT TIG(NC2) ALONG
(RXV)XR. IN FPS
TO NEAREST .1
FPS.

DELTA VY(LV) -
COMPONENT OF IM-
PULSIVE DELTA V
AT TIG(NC2) ALONG
VXR. IN FPS TO
NEAREST .1 FPS.

DELTA VZ(LV) -
COMPONENT OF IM-
PULSIVE DELTA V
AT TIG(NC2) ALONG
-R. IN FPS TO
NEAREST .1 FPS

WHERE R IS CSM
GEOCENTRIC RADIUS
VECTJR AND V IS
CSM INERTIAL VEL-
OCITY VECTOR AT
TIG(NC2).

WAIT FOR KEYBOARD
ENTRY

AND DISPLAY OF
DELTA V(LV) FOR
NC2

NOTE: N81 VALUES
WILL BE ZERO IF
PRD WAS KEYED
AFTER ALARM 600,
601 OR 603.

AM I SATISFIED
WITH THESE
VALUES?

(NOTE: CREW HAS
THE OPTION AT
THIS TIME TO RE-
DEFINE THE DELTA
V(LV) FOR NC2
COMPONENTS FOR
THE SUBSEQUENT
THRUSTING
MANEUVER.)

.Y .N

KEY IN V25E
AND LOAD DE-
Sired DELTA V
VALUES

RECORD THESE
VALUES

KEY IN PROCEED

TERMINATE FLASH
UPON RECEIPT OF
PROCEED, OR NEW
DATA.

SET EXTERNAL DELTA V
FLAG

IS FINAL FLAG SET?

$$z.$$

```
SET MGA DISPLAY
IN R3 (BELOW) =
-00001.
```

IS REFSMAT FLAG
SEV?

 $z \cdot y$

COMPUTE IMU
MIDDLE GIMBAL
ANGLE AT TIG
(INC2) FOR THE
PRESENT IMU
ORIENTATION
WITH THE CSM
+X AXIS ALIG-
NED WITH THE
INITIAL
THRUST VECTOR

SET MGA DIS-
PLAY IN R3
(BELOW) =
-00002.

HCOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE AND
MCN . DISPLAY MARK COUN-
TERS, TFI AND MGA:
V16N45

MONITOR DSKY:
OBSERVE VERB-NOJN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF MARK COUNTERS,

Page 18

#670

0494

#650

#660

#680

ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
THE PROGRAM THE
VALUE IS -00001

(B) ON THE LAST
PASS WHEN THE IMU
IS NOT ALIGNED
THE VALUE IS
-000J2.

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED.

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED,
OR RECYCLE.

P
R
O
C
E
E
D

RESET
UPDATE

GO TO
PAGE
ABOVE

KEY IN RECYCLE
V32E

#730

0740

#750

#760

#770

#780

#790

#800

#810

#820

FLAG

.
.
.
...
.
GO TO
"A"
ABOVE

IS FINAL FLAG SET?

.Y N.
.
.
.

SET FINAL FLAG

.
.
.

RESET UPDATE
FLAG

.
.
.

GO TO
"A"
ABOVE

SET MANEUFL G

.
.
.

IS THIS MINKEY?
(IS AUTOSEQ FLAG

```
SET? )-----
.Y      .N
.
.
.
.
-----
CHANGE 4-MATRIX
REINITIALIZATION
VALUES TO 2000
F, 2 FPS.
-----
.
.
.
.
DO ROUTINE R00 ----- DO ROUTINE R00
.
.
.
.
EXIT P32
EXIT P32
```

#830

#840

#850

CHANGE CONTROL NOTES

REV 00 PCR 021,042,448, SL MEMO #2
REV 01 PCN 489

NCC TARGETING PROGRAM (P33)

REV 01 03/20/72

PURPOSE:

- (1) TO CALCULATE PARAMETERS ASSOCIATED WITH THE NCC MANEUVER FOR LAMBERT STEERING DELTA V BURNS.
- (2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE DSKY BY THE ASTRONAUT.
- (3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NCC MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.
- (4) TO STORE THE NCC TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS:

- (1) THIS PROGRAM IS BASED UPON PREVIOUS COMPLETION OF THE NC2 TARGETING PROGRAM (P32).

THEREFORE:

- (A) AT A SELECTED TPI TIME (NOW IN STORAGE) THE LINE OF SIGHT BETWEEN THE CSM AND THE OWS WAS SELECTED TO BE A PRESCRIBED ANGLE (E) (NOW IN STORAGE) FROM HORIZONTAL PLANE DEFINED AT THE ACTIVE VEHICLE POSITION.
- (3) THE NCC AND NSR MANEUVERS WERE ASSUMED TO BE PARALLEL TO THE PLANE OF THE OWS ORBIT. HOWEVER, THE N81 DISPLAY IS MODIFIED TO ESTABLISH AN ANTINODE AT NSR.

- (2) CMC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND.

- (3) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE JDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.

- (4) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

- (5) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

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PROG
CONT

CMC	GROUND	CREW
.AUTOMATIC		.CREW
.PROGRAM		.PROGRAM
.SELECTION		.SELECTION
.		.
...		...
.		.

DO R00 TO START NCC TARGETING PROGRAM (P33) DISPLAY P33	KEY IN NCC TARGET- ING PROGRAM (P33) V37E 33E
--	-------	---

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#20

#30

#40

#50

#60

.....
MONITOR DSKY:
OBSERVE DISPLAY OF
P33

"START"

SET TRACK FLAG

SET UPDATE FLAG

RESET PCFLAG

"START"

HOLD .
.....
SNAP .
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED TIG
(NCC):
VOG N11

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED TIG

R1-TIG(NCC)-HRS
R2-TIG(NCC)-MIN
R3-TIG(NCC)-SECS

TIG(NCC) - TIME OF
NCC IGNITION (GET).
IN HRS, MINS, SECS
TC NEAREST .01 SEC.

(NCC).

AM I SATISFIED WITH
THIS VALUE?

.Y .N

RECORD THIS
VALUE

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V25E
AND LOAD
DESIRED VALUE

.P .NEW
.R .DATA
.O .
.C .
.E .
.E .STORE DATA
.D .

HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY COMPUTED
TIG(NSR):

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

#70

#80

#90

#100

#110

V06 N13
R1-TIG(NSR)-HRS
R2-TIG(NSR)-MINS
R3-TIG(NSR)-SECS

TIG(NSR)-TIME OF NSR
IGNITION (GET). IN
HRS, MINS, SECS TO
NEAREST .01 SEC.

OF STORED TIG(NSR).

#120

AM I SATISFIED WITH
THIS VALUE?

.Y .N

#130

RECORD THIS
VALUE

#140

KEY IN PROCEED

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V25E
AND LOAD DE-
SIRE VALUE

#150

.PROCEED
.NEW
.DATA

STORE DATA

#160

HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED
TIG(TPI):

MONITOR USKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

#170

V06 NJ7
R1-TIG(TPI)-HRS
R2-TIG(TPI)-MINS
R3-TIG(TPI)-SECS

TIG(TPI)-TIME OF TPI
IGNITION (GET). IN
HRS, MINS, SECS, TO
NEAREST .01 SEC.

OF STORED TIG(TPI)

AM I SATISFIED WITH
THIS VALUE?

.YES .NO

RECORD THIS
VALUE

#190

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

#200

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.PROCEED .NEW
.DATA

#210

STORE DATA

KEY IN V25E
AND LOAD THE
DESIRED VALUE

#220

RESET FINAL
FLAG

180
P33/SKYLARK

#470

#480

#490

#500

#510

#520

VALUES?
(NOTE: CREW HAS
THE OPTION AT
THIS TIME TO
REDEFINE THE
COMPONENTS FOR
THE SUBSEQUENT
THRUSTING MAN-
EUVER.)

.Y .N

KEY IN V25E
AND LOAD DE-
SIRED VALUES

RECORD THESE
VALUES

KEY IN PROCEED

DELTA V(LV) -
COMPONENT OF IM-
PULSIVE DELTA V
AT TIGINCC) ALONG
VXR. IN FPS TO
NEAREST .1 FPS

DELTA VZ(LV) -
COMPONENT OF IM-
PULSIVE DELTA V
AT TIGINCC) ALONG
-R. WHERE R IS
CSM GEOCENTRIC
RADIUS VECTOR AND
V IS CSM INERTIAL
VELOCITY VECTOR
AT TIGINCC). IN
FPS TO NEAREST
.1 FPS

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW
DATA.

.P .NEW
.R .DATA

.D .STORE DATA
.C .
.E .
.E .
.D .
. .
. .
. .
. .
. .

#530

#540

#550

#560

#570

VHF RANGING MARK
COUNTER AND THE TWO
LEAST SIGNIFICANT
DIGITS IS THE OPTICS
MARK COUNTER.
(NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACKUP AND
PRIMARY MARKS.)

TFI - TIME FROM TIG
(NCC). IN MIN AND
SEC TO NEAREST SEC.
MAX READING IS 59859.
SIGN IS - BEFORE +
AFTER TIG(NCC).

MGA - MIDDLE GIMBAL
ANGLE AT TIG(NCC)
IF CSM +X AXIS IS
ALIGNED WITH INITIAL
THRUST DIRECTION. IN
DEGREES TO NEAREST
.01 DEGREE
SIGN IS ALWAYS +
EXCEPT;

(A) WHEN DISPLAY-
ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
THE PROGRAM THE
VALUE IS -00001

(B) ON THE LAST
PASS WHEN THE IMU
IS NOT ALIGNED
THE VALUE IS
-00002. IN DEGREES
TO NEAREST .01
DEGREE

WAIT FOR KEYBOARD
ENTRY

#620

#630

#640

#650

#660

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y N.

DO I WISH TO
TERMINATE THE
MARK PROCESS AND
DO THE FINAL PASS
THROUGH THE
PROGRAM?

.Y N.

KEY IN
PROCEED.

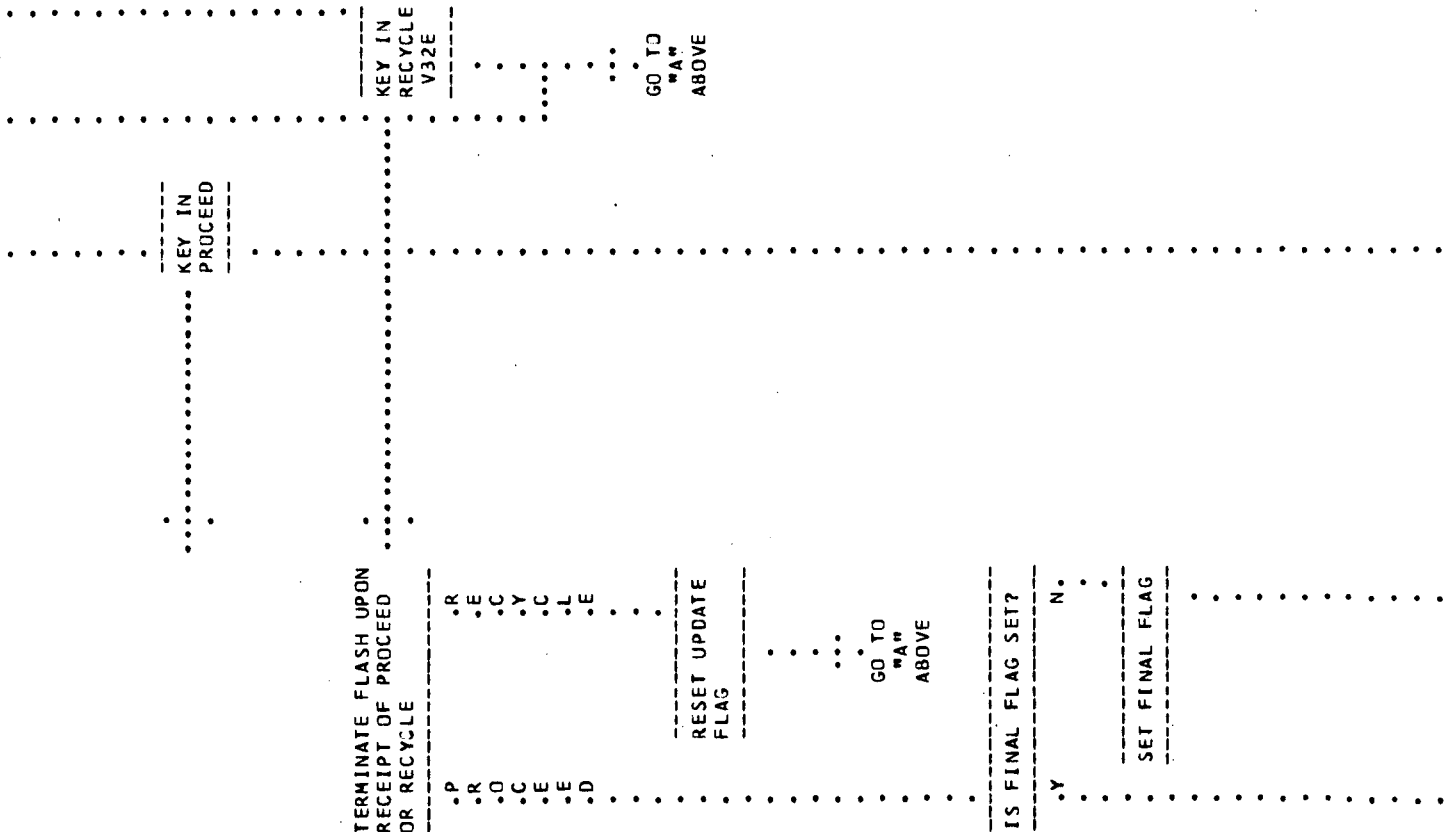
#670

#680

#690

#700

#710



#760

186

```

DO ROUTINE R00
.....
DO ROUTINE R00

```


NSR TARGETING PROGRAM (P34).

REV 01 03/20/72

PURPOSE:

- (1) TO CALCULATE PARAMETERS ASSOCIATED WITH THE NSR MANEUVER FOR DELTA V BURNS.
- (2) TO CALCULATE THESE PARAMETERS BASED UPON MANEUVER DATA APPROVED AND KEYED INTO THE DSKY BY THE ASTRONAUT.
- (3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND DEPENDENT VARIABLES ASSOCIATED WITH THE NSR MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.
- (4) TO STORE THE NSR TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS:

- (1) THIS PROGRAM IS BASED UPON PREVIOUS COMPLETION OF THE VC1(P31), N-2(P32), NCC(P33) TARGETING PROGRAMS. THEREFORE:

- (A) AT A SELECTED TPI TIME (NOW IN STORAGE) THE LINE OF SIGHT BETWEEN THE CSM AND THE OWS WAS SELECTED TO BE A PRESCRIBED ANGLE (E) (NOW IN STORAGE) FROM THE HORIZONTAL PLANE DEFINED AT THE ACTIVE VEHICLE POSITION.
- (B) THE NSR MANEUVER IS ASSUMED TO BE PARALLEL TO THE PLANE OF THE OWS ORBIT. HOWEVER, OUT-OF-PLANE PARAMETERS ARE COMPUTED FOR TIG(NSR) AND ARE AVAILABLE BY KEYING V06N30 E AT FL V16 N45 AFTER A COMP CYCLE. IN ADDITION, THE N81 DISPLAY IS MODIFIED TO ESTABLISH AN ANTINODE AT NSR.
- (2) C4C COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND.
- (3) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.
- (4) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.
- (5) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

PROG
CONT

CMC	GROUND	CREW
.AUTOMATIC		.CREW
.PROGRAM		.PROGRAM
.SELECTION		.SELECTION
.		.
.		.
...		...
.		.
DO R00 TO START NSR	KEY IN NSR TARGET-
TARGETING PROGRAM	.	ING PROGRAM (P34)
(P34)		V37E 34E
DISPLAY P34		-----
		.
		.
		.
		.

#10

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MONITOR DSKY:
OBSERVE DISPLAY OF
P 34

#20

"START"

SET TRACK FLAG

SET UPDATE FLAG

RESET PCFLAG

“START”

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED FIG
(NSR):

V06 V13

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF STORED TIG

098

PLAY ALARM
CODE:
V05N09
R1-
R2-
R3-

THE EXPECTED
ALARM AT THIS
TIME IS 00611

ONAL DIFFICULTY?

.N Y.

DO I WISH TO
READJUST TIG?

.Y .N

KEY IN RE-
CYCLE
V32E

WAIT FOR KEY-
BOARD ENTRY

RETURN
TO
"START"

DO I WISH TO
ATTEMPT TO
DEFINE NSR
MANEUVER
ANYWAY, RE-
ALIZING THAT
DELTA H
(NSR), DELTA
T(TPI-NSR) AND
DELTA
T(TPI-NOMTPI)
ARE NOT

#170

#180

#190

#200

#210

[illegible]

TIG(TPI) AS DE-
FINED IN N37
AFTER PRO TO N13.
COMPUTED IN
HRS, MINS, AND
SECS OF WHICH
ONLY THE MINS AND
SECS ARE DIS-
PLAYED.

NOTE 1: TIG(TPI)
IS AVAILABLE BY
KEYING IN V06N37

NOTE 2: R2 IS
COMPUTED MODULE
ONE HOUR IF IT IS
POSITIVE. IF IT
IS NEGATIVE IT IS
LIMITED INSTEAD.
R3 IS ALWAYS
MODULE ONE HOUR.

RECORD THESE
VALUES

KEY IN PROCEED

TERMINATE FLASH
UPON RECEIPT OF
PROCEED

FLASH VERB-NOUN
TO REQUEST PES-
PONSE AND DISPLAY
CALCULATED COM-

MONITOR DSKY:
OBSERVE VERR-
NOUN FLASH TO
REQUEST RE-

#420

0630

○ウウウ

0540

094#

P34/SKYLARK


```
(A) WHEN DISPLAY-
ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
THE PROGRAM THE
VALUE IS -00001

(B) IN THE LAST
```

0554

 $\gamma \cdot z$

PASS WHEN THE IMU
IS NOT ALIGNED
THE VALUE IS
-0002. IN DEGREES
TO NEAREST .01
DEGREE

#560

WAIT FOR KEYBOARD
ENTRY

025#

KEY IN
PROCEED

085#

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

KEY IN RECYCLE
V32E

P	R
.	E
R	C
O	Y
C	C
E	L
E	E
D	.
.	.

#590

RESET UPDATE
FLAG

01.05

GO TO
"A"
ABOVE

006

.....
"A"
ABOVE
.....

#610

IS FINAL FLAG SET?

Y N
.....

SET FINAL FLAG

.....

RESET UPDATE
FLAG

.....

SET MANEUFLG

GO TO
"A"
ABOVE
.....

#630

IS THIS MINKEY?
(IS AUTOSEQ FLAG
SET?)

Y N
.....

#640

CHANGE
W-MATRIX
REINITIAL-
ZATION
VALUES TO
2000 F,
.....

#650

2FPS

[illegible]

CHANGE CONTROL NOTES

REV 00 PCR 011, PCN 412, SKYLARK MEVD #2
REV C1 PCR 489

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TPI TARGETING PROGRAM (PJ5)

REV 01 03/23/72

PURPOSE:

++
+01
+
+489
++

(1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE CMC FOR EXECUTION OF THE TRANSFER PHASE INITIATION MANEUVER, GIVEN:

- (A) TIME OF IGNITION TIG (TPI) OR THE ELEVATION ANGLE (E) OF THE CSM/DMS LOS AT TIG(TPI)
- (B) CENTRAL ANGLE OF TRANSFER (CENTANG) OF 130 DEGREES FROM TIG(TPI) TO INTERCEPT TIME (TIG(TPF)).

(2) TO CALCULATE TIG (TPI) GIVEN E OR E GIVEN TIG (TPI).

(3) TO DISPLAY TO THE ASTRONAUT AND THE GROUND CERTAIN DEPENDENT VARIABLES ASSOCIATED WITH THE MANEUVER FOR APPROVAL BY THE ASTRONAUT/GROUND.

(4) TO STORE THE TPI TARGET PARAMETERS FOR USE BY THE DESIRED THRUSTING PROGRAM.

ASSUMPTIONS:

(1) THE PROGRAM MUST BE DONE OVER A TRACKING STATION FOR REAL TIME GROUND PARTICIPATION IN AGC DATA INPUT AND OUTPUT. AGC COMPUTED VARIABLES MAY BE STORED FOR LATER VERIFICATION BY THE GROUND. THESE STORAGE CAPABILITIES ARE LIMITED ONLY TO THE PARAMETERS FOR ONE THRUSTING MANEUVER AT A TIME.

(2) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW VHF RANGING MARKS TO ACCUMULATE. (HOWEVER, IF THE UPDATE FLAG IS NOT SET THE MARKS WOULD NOT BE INCORPORATED OR ACCUMULATED).
SEE P20 FOR DETAILED DESCRIPTION.

(3) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.

THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPTJ TARGETING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.

(4) WHEN DETERMINING THE INITIAL POSITION AND VELOCITY OF THE TARGET AT INTERCEPT TIME, EITHER CONIC OR PRECISION INTEGRATION MAY BE USED.

(5) THE OPERATION OF THE PROGRAM UTILIZES THE FOLLOWING FLAGS:

FINAL FLAG - SELECTS FINAL PROGRAM DISPLAYS AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.

EXTERNAL DELTA V FLAG - RESET BY THIS PROGRAM WHICH DESIGNATES THAT LAMBERT STEERING IS REQUIRED FOR EXECUTION OF THIS MANEUVER BY THE THRUSTING PROGRAM SELECTED AFTER COMPLETION OF THIS PROGRAM.

(6) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(7) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKY CONTROLLER (ROT).

(8) THE DELTA V IN LOS COORDINATES (N59) IS AVAILABLE AT FL V16 N45 AFTER EACH COMPUTATION CYCLE.

PROG

CMC

GROUND

CREW

P35/SKYLARK

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CONT

•AUTOMATIC
•PROGRAM
•SELECTION
.
.
...

•CREW PROG.
•SELECTION
.
.
...

DC R00 TO START TPI
TARGETING PROGRAM
(P35) DISPLAY PRO-
GRAM P35

KEY IN TPI TARGETING
PROGRAM (P35)

MUNITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 35

"START"

INITIALIZE NN=0

SET TRACK FLAG
(SEE P2J)

SET UPDATE FLAG
(SEE P2J)

#10

#20

#30

#40

#50

++
+01
+
+464
++

RESET TPIINFLG

.
.

RESET PCFLAG

"START"

#60

.
.
.

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY TIG(TPI):

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF TIG (TPI).

#70

V06N37
R1-TIG (TPI)-HRS
R2-TIG (TPI)-MIN
R3-TIG (TPI)-SEC

TIG(TPI)-TIME OF TPI
IGNITION (GET).
IN HRS, MIN, SEC
TO NEAREST .01 SEC.

#80

AM I SATISFIED WITH
THIS VALUE?
(NOTE: THIS PROGRAM
ALWAYS REQUIRES AN
INITIAL VALUE OF
TIG(TPI) WHICH IS
WITHIN 30 MINUTES
OF THE ACTUAL VALUE
EVEN IF TIG (TPI) IS
TO BE CALCULATED
FROM A SPECIFIED E.)

#90

.Y
N.

RECORD THIS
VALUE.

#100

#110

#120

#130

#140

#150

WAIT FOR KEYBOARD ENTRY

TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA

P NEW
R DATA
O
C
E STORE DATA
E
D

KEY IN V25E AND LOAD THE DESIRED TIC

HOLD
FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY NN AND E:
V06 N55
R1-NN
R2-E
R3-BLANK
NN-THE NUMBER OF TARGET OFFSETS.
NOTE:
WHEN NN=0 USE CONTC

MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF NN AND E.
IF I WISH TO HAVE THE CMC

INTEGRATION TO
DETERMINE THE
INITIAL POSITION
AND VELOCITY OF
THE TARGET AT
INTERCEPT TIME.
WHEN NN=NOV 0 USE
THE INDICATED NUMBER
OF OFFSETS.

E-ELEVATION ANGLE
BETWEEN THE CSM/DOMS
LOS AND THE CSM
LOCAL HORIZONTAL AT
TIGITPI) REFERENCED
TO THE DIRECTION OF
FLIGHT (SEE SECTION
5.4 OF R693
FOR DETAILED DESCRIP-
TION). FROM 0 TO
360 IN DEGREES TO
NEAREST .01 DEGREE.

• • • • •

WAIT FOR KEYBOARD
ENTRY

```
MAKE THE TARGET-
ING CALCULA-
TIONS USING CO-
NIC INTEGRATION,
R1 SHOULD BE SET
TO +0000 BEFORE
PROCEEDING ON
THIS DISPLAY;
OTHERWISE IT
SHOULD BE SET
TO +00002.
```

```
IF I WISH TO
HAVE THE CMC
CALCULATE E, R2
SHOULD BE SET
TO +0000 BEFORE
PROCEEDING ON
THIS DISPLAY;
OTHERWISE R2
SHOULD CONTAIN
THE E THAT I
WISH TO USE.
E IS A
PAD-LOADED
ERASABLE.
```

• • • • •

AM I SATISFIED WITH THESE VALUES?

7.

8.

KEY IN V21E THRU
V24E (AS THE CASE
MAY BE) AND LOAD

•

THE DESIRED DATA

#210

RECORD THESE VALUES

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

NEW DATA
STORE DATA

#230

GO TO
"B"

BELOW

RESET COMP E
FLAG

IS E SPECIFIED TO
BE +000J07

Y N

SET COMP E FLAG

#240

#250

FINITION SEE
ABOVE).

RECORD THIS
VALUE

WAIT FOR KEY-
BOARD ENTRY

KEY IN PRO-
CEED.

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED

.P
.R
.O
.C
.E
.E
.D

COMPUTE TIG
(TPI) FOR THE
SPECIFIED E.
ESTABLISH
ALARM IF NO
SOLUTION CAN
BE REACHED

.N
.O
.A
.L
.A
.R
.M

#300

#310

#320

#330

#340

PCSS
HOLD
.....
SNAP

A
R
M FLASH VERB-
NUON TO
REQUEST RE-
SPONSE AND
DISPLAY
ALARM CODE:
V05N09
R1-
R2-
R3-
EXPECTED
ALARM CODE
AT THIS
TIME IS
0J611

MONITOR DSKY:
DOES ALARM
CODE DISPLAY
INDICATE THAT
NO SOLUTION
CAN BE
REACHED?

.Y .N.

WAIT FOR
KEYBOARD
ENTRY
TERMINATE
FLASH UPON
RECEIPT OF
PROCEED

RETURN TO
START OF
PROGRAM
AND ADJUST
INPUT PARA-
METERS.
KEY IN
PROCEED.

.PRO
.
.
.
GO TO
"START"
ABOVE

.
.
.
GO TO
"START"
ABOVE

PCSS
HOLD
.....
SNAP
FLASH VERB-
NUON TO RE-
QUEST RESPONSE
AND DISPLAY
CALCULATED

MONITOR DSKY:
OBSERVE
VERB-NUON
FLASH TO RE-
QUEST RE-

#350

#360

#370

#380

#390

(NOTE: FOR DEFINITION SEE ABOVE).

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED.

IS THIS MINKEY?
(IS AUTOSEQ
FLAG SET?)

IS FINAL FLAG
SET?

...

...

• • • • •

2

• • • • •

•

•

•

• •

•

• •

• •

• • • • •

• • • • •

•

214

P35 / SKYLARK

0548

#460

0254

08480

06490

P35/SKYLARK

```

METERS ASSOC-      •
LATED WITH         •
TPI AND TPF        •
AS DESCRIBED       •
IN SECTION         •
5.4 OF R693.      •
-----
•
•
•
•
•
-----
• USING PRECI-
  SION INTEGRA-
  TION AND NN
  OFFSETS COM-
  PUTE THE PARA-
  METERS ASSOC-
  IATED WITH
  TPI AND TPF
  AS DESCRIBED
  IN SECTION
  5.4 OF
  R693.

```

RESET EXTERNAL
DELTA V FLAG

FLASH VERB-NOUN
TO REQUEST RE-
SPONSE AND DIS-
PLAY CALCULATED
DELTA V(TPI),
DELTA V(TPF), AND

POSS
HOLD .
.....
SNAP .

MONITOR DSKY:
OBSERVE VERB-
NOUN FLASH TO
REQUEST RESPONSE
AND DISPLAY OF
CALCULATED DELTA

#500

4510

#520

#530

UPON RECEIPT OF
PROCEED

.PRQ

IS FINAL FLAG
SET?

.N Y.

SET TPINNFLG.

SET UP-
DATE
FLAG
(SEE
P20)

POSS
HOLD

SNAP

FLASH VERB-
NOUN TO RE-
QUEST RESPONSE
AND DISPLAY
CALCULATED

MONITOR DSKY:
OBSERVE
VERB-NOUN
FLASH TO RE-
QUEST RES-

#590

#600

#610

#620

#630

COMPONENTS OF
DELTA V(LV)
FOR TPI:
V06N81
R1-DELTA
VX(LV)
R2-DELTA
VY(LV)
R3-DELTA
VZ(LV)

DELTA VX(LV) -
COMPONENT OF
IMPULSIVE
DELTA V AT
TIG(TPI) ALONG
(XV)X. IN
FPS TO NEAREST
.1 FPS.

DELTA VY(LV) -
COMPONENT OF
IMPULSIVE
DELTA V AT
TIG(TPI) ALONG
VX. IN FPS TO
NEAREST .1 FPS

DELTA VZ(LV) -
COMPONENT OF
IMPULSIVE
DELTA V AT
TIG(TPI) ALONG
-Z. IN FPS TO
NEAREST .1 FPS

WHERE R IS THE
CSM GEODETIC
RADIUS VECTOR
AND V IS THE
CSM INERTIAL
VELOCITY
VECTOR AT
TIG(TPI).

PONSE AND
DISPLAY OF
DELTA V(LV)
FOR TPI

AM I SATIS-
FIED WITH
THESE VALUES?
(NOTE: CREW
HAS THE OP-
TION AT THIS
TIME TO RE-
DEFINE THE
DELTA V(LV)
COMPONENTS
FOR THE SUB-
SEQUENT THRU-
STING MANEU-
VER. THIS
CAPABILITY
WILL NORMALLY
BE EXERCISED
TO CORRECT
OUT OF PLANE-
NESS BY FIRST
SELECTING THE
RENDEZVOUS
OUT-OF-PLANE
DISPLAY ROU-
TINE (R36)
(V90E), AND
THEN MODIFY-
ING DELTA
VY(LV).)

.Y N.

#640

#650

#660

#670

#680

+489
++

WAIT FOR KEY-
BOARD ENTRY

KEY IN V25E
AND LOAD
THE DESIRED
VALUES.

RECORD THESE
VALUES

TERMINATE
FLASH UPON RE-
CEIPT OF PRO-
CEED OR NEW
DATA

KEY IN
PROCEED

WAS NEW DATA
LOADED?

220

0740

052#

#760

#770

081第

SET MGA DIS-
PLAY IN R3
(BELOW) =
-00002.

HOLD .
.....
MON .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY MARK CTRS
TFI AND MGA;
VI6N45
R1 - MARK CTRS
R2 - TFI
R3 - MGA

MARK CTRS - THE NUMBER OF MARKS PROCESSED BY THE RENDEZ-VOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE LAST W-MATRIX REINITIALIZATION. (REFER TO ASSUMPTION (8) OF P20). THE REGISTER WILL DISPLAY XXBX WHERE THE TWO MOST SIGNIFICANT DIGITS IS THE VHF RANGING MARK COUNTER AND THE

118

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF MARK CTRS, TFI
AND MGA.

MARK CTRS - THE NUMBER OF MARKS PROCESSED BY THE RENDEZ-VOUS TRACKING DATA PROCESSING ROUTINE (R22) SINCE LAST W-MATRIX REINITIALIZATION. (REFER TO ASSUMPTION (8) OF P20). THE REGISTER WILL DISPLAY XXBX WHERE THE TWO MOST SIGNIFICANT DIGITS IS THE VHF RANGING MARK COUNTER AND THE

TWO LEAST SIGNIFICANT DIGITS IS THE OPTICS MARK COUNTER. NOTE: THE OPTICS MARK COUNTER DOES NOT DISTINGUISH BETWEEN BACKUP AND PRIMARY MARKS.

TFI-TIME FROM
TIG(TPI). IN MIN AND
SEC TO NEAREST SEC.
MAX READING IS
59859. SIGN IS
- BEFORE + AFTER
TIG(TPI).

MGA-MIDDLE GIMBAL
ANGLE AT YIG(TPI) IF
CSM +X AXIS IS ALIG-
NED WITH INITIAL-
THRUST DIRECTION.
SIGN IS ALWAYS +
EXCEPT:

(A) WHEN DISPLAY-
ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
THE PROGRAM THE
VALUE IS -00001

(B) ON THE LAST
PASS WHEN THE IMU
IS NOT ALIGNED
THE VALUE IS
-0002.
IN DEGREES TO THE
NEAREST .01 DE-
GREES.

• • •

WAIT FOR KEYBOARD
ENTRY

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

$$z_{\gamma}$$

- DO I WISH TO
- TERMINATE THE
- MARKING PROCESS
- AND DO THE FINAL
- PASS THROUGH THE
- PROGRAM?

$$\gamma \cdot \mathbf{z}$$

KEY IN
PROCEED.

#870

0488

058#

0988

P35/SKYLARK

225

253
P35/SKYARK

RESET UPDATE
FLAG

GO TO
"A"
ABOVE

SET MANEUFLG

IS THIS MINKEY?
(IS AUTOSEQ FLAG
SET?)

$$\begin{matrix} z. \\ y. \end{matrix}$$

CHANGE # - MATRIX
RFINITIALIZATION
VALUES TO 2000 F.
2FPS

-----DC ROUTINE R00

DU ROUTINE R00

EXIT P35

EXIT P35

#930

046#

#950

#960

#970

P35/SKYLARK

CHANGE CONTROL NOTES

REV 00 PCR J11, PCN 412,455, SKYLARK MEMO #2
REV 01 PCR 464, PCN 489

C

TPM TARGETING PROGRAM (P35)

REV 00 05/19/71

PURPOSE:

(1) TO CALCULATE THE REQUIRED DELTA V AND OTHER INITIAL CONDITIONS REQUIRED BY THE CMC FOR CSM EXECUTION OF THE NEXT MIDCOURSE CORRECTION OF THE TRANSFER PHASE OF AN ACTIVE CSM RENDEZVOJS.

ASSUMPTIONS:

(1) IF P20 IS IN OPERATION WHILE THIS PROGRAM IS OPERATING THE ASTRONAUT MAY HOLD AT ANY FLASHING DISPLAY AND TAKE OPTICS MARKS AND/OR HE MAY ALLOW THE RANGING MARKS TO ACCUMULATE. (HOWEVER IF THE UPDATE FLAG IS NOT SET THE MARKS WILL NOT BE INCORPORATED OR ACCUMULATED) SEE P20 FOR DETAILED DESCRIPTION.

(2) ONCE THE PARAMETERS REQUIRED FOR COMPUTATION OF THE MANEUVER HAVE BEEN COMPLETELY SPECIFIED, THE VALUE OF THE ACTIVE VEHICLE CENTRAL ANGLE OF TRANSFER IS COMPUTED AND STORED. THIS NUMBER WILL BE AVAILABLE FOR DISPLAY TO THE ASTRONAUT THROUGH THE USE OF V06N52.

THE ASTRONAUT WOULD CALL THIS DISPLAY TO VERIFY THAT THE CENTRAL ANGLE OF TRANSFER OF THE ACTIVE VEHICLE IS NOT WITHIN 170 TO 190 DEGREES. IF THE ANGLE IS WITHIN THIS ZONE THE ASTRONAUT SHOULD REASSESS THE INPUT TARGETING PARAMETERS BASED UPON DELTA V AND EXPECTED MANEUVER TIME.

(3) THE OPERATION OF THIS PROGRAM UTILIZES THE FOLLOWING FLAGS:

EXTERNAL DELTA V FLAG - RESET BY THIS PROGRAM WHICH DESIGNATES THAT LAMBERT STEERING IS REQUIRED FOR EXECUTION OF THIS MANEUVER BY THE THRUSTING PROGRAM SELECTED AFTER COMPLETION OF THIS PROGRAM.

FINAL FLAG - SELECTS FINAL PROGRAM DISPLAY AFTER CREW HAS SELECTED THE FINAL MANEUVER COMPUTATION CYCLE.

(4) THE TIME OF INTERCEPT (TINTT) WAS DEFINED BY PREVIOUS COMPLETION OF THE TPI TARGETING PROGRAM (P35) AND IS PRESENTLY AVAILABLE IN CMC STORAGE.

(5) THE DELTA V IN LV COORDINATES IS AVAILABLE IN N81.

(6) THERE IS NO REQUIREMENT FOR ISS OPERATION TO PERFORM THIS PROGRAM.

(7) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R07).

PRG
CNT

CMC

• AUTOMATIC
• PROGRAM
• SELECTION
•
•

GROUND

CREW

• CREW
• PROG
• SELECTION
•
•

00 R00 TO START TPM
TARGETING PROGRAM
(P36).
DISPLAY PROGRAM 36.

KEY IN TPM TARGETING
PROGRAM (P36)
V37E 36E

• • • •

SET TPI4NFLG

MC738
"Em
01000

• • •

075

• • •

• • •

10.

USING CONIC
INTEGRATION
AND 0 OFF-
SETS CALCUL-
ATE THE
REQUIRED
VELOCITY FOR
THE MID-
COURSE
CORRECTION

• • •

• • •

- USING PRECISION INTEGRATION AND OFFSETS CALCULATE THE REQUIRED VELOCITY FOR THE MIDCOURSE CORRECTION

• • •

IS FINAL FLAG
SET?

$$\begin{matrix} \bullet \\ \gamma \\ \bullet \end{matrix} \quad \begin{matrix} \bullet \\ z \\ \bullet \end{matrix}$$

#160


#170

#180

061#

#200

263
P36/SKYLARK



Reproduced from
best available copy.

#270

#280

#290

#300

P36/SKYLARK

.....
HOLD .
MCN .
FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OF MARK CTRS
TFI AND MGA:

.....
MONITOR DISKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

.....
"B"
.
.
...
.

.....
MONITOR DISKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

264
P36/SKYLARK
#310
#320
#330
#340
#350

VL6N+5
R1-MARK CTRS
R2-TFI
R3-MJA

MARK CTRS - THE
NUMBER OF MARKS PRO-
CESSED BY THE REND-
EVIOUS TRACKING DATA
PROCESSING ROUTINE
(R22) SINCE THE LAST
W-MATRIX REINITIALI-
ZATION.
(REFER TO ASSUMPTION
(8) OF P20).
THE REGISTER WILL
DISPLAY XXBXX WHERE
THE TWO MOST SIGNIF-
ICANT DIGITS IS THE
VHF RANGING MARK
COUNTER AND THE TWO
LEAST SIGNIFICANT
DIGITS IS THE OPTICS
MARK COUNTER

NOTE : THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH BE-
TWEEN BACKJP AND
PRIMARY MARKS.

TFI-TIME FROM TIG
(TPM) IN MIN AND SEC
TO NEAREST SEC. MAX
READING IS 59859.
SIGN IS - BEFORE +
AFTER TIG(TPM).

MGA-MIDDLE GIMBAL
ANGLE AT TIG(TPM) IF
CSM + X AXIS IS ALIG-
NED WITH INITIAL
THRUST DIRECTION.
SIGN IS ALWAYS +
EXCEPT:

(A) WHEN DISPLAY-
ED AT ANY TIME

OF MARK CTRS, TFI
AND MGA.

.....

WAS THIS THE LAST
PASS THROUGH THE
PROGRAM?

.Y .N.

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

. . .

#360

#370

#380

#390

#400

• • •

KEY IN
PROCEED.

• • •
•
•
•
•
•
•
•
•
•

GO TO
"A"
ABOVE

〇々々々

237

267
P36/SKYLARK

0545

#460

0248

0875

064番

P36/SKYLARK

RENDEZVOUS FINAL PHASE PROGRAM (P37)

REF 01 03/20/72

PURPOSE:

- (1) TO ESTABLISH X-AXIS TRACKING (P20, WITH RHO AND GAMMA=0 DEG.)
- (2) TO SELECT R31 INTERNALLY TO PROVIDE RANGE AND RANGE RATE INFORMATION PRIOR TO THE BRAKING PHASE OF RENDEZVOUS.

ASSUMPTIONS:

- (1) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR BY THE MINKEY CONTROLLER.

PROG
CONT

CMC

GROUND

CREW

•AUTOMATIC
•PROGRAM
•SELECTION
.
.
...

•CREW
•PROGRAM
•SELECTION
.
.
...

DO RJO TO START
RENDEZVOUS FINAL
PHASE PROGRAM (P37)
DISPLAY P37

KEY IN RENDEZVOUS
FINAL PHASE PROGRAM
(P37)
V37E 37E

#10

#20

#30

MONITOR DSKY:
OBSERVE DISPLAY
OF P37

SET UPDATE FLAG

060

START

SET TRACK AND UPDATE FLAGS

SET PCFLAG

RESET FINAL
FLAG

START

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY LAST TIG:
V06 V39

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

R1-TIG-HRS R2-TIG-MINS R3-TIG-SECS	OF LAST TIG	
TIG - TIME OF LAST MANEUVER IN HRS, MINS, SEC TO NEAREST .01 SEC.		
	AM I SATISFIED WITH THIS VALUE?	
	.Y .N	
	RECORD THIS VALUE	
WAIT FOR KEYBOARD ENTRY	KEY IN PROCEED	
TERMINATE FLASH UPON RECEIPT OF PROCEED OR NEW DATA	KEY IN V25E AND LOAD DESIRED VALUE	
.PRO .NEW DATA		
STORE DATA		
SET EXTERNAL DELTA V FLAG		

#70

#80

#90

#100

#110

COMPUTE THE TIME 1/4
PERIOD FROM THE TIME
IN N39 AND STORE IN
N33

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY COMPUTED
TIG FOR PC:
V06 V33
R1-TIG - HRS
R2-TIG - MIN
R3-TIG - SECS

TIG - TIME OF PC
IGNITION (GET).
IN HRS, MINS, SEC TO
NEAREST .01 SEC.

WAIT FOR KEYBOARD
ENTRY

GO TO

MC 738
"5"

#170

#180

#190

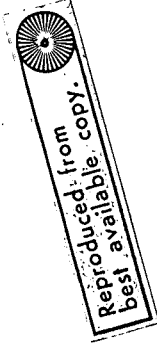
#200

#210

P38/SKYLARK

• • • • •

#260



SIVE DELTA V AT TIG
FOR PC ALONG
(RXV)XR. IN FPS TO
NFAEST .1 FPS.

DELTA VY(LV) -
COMPONENT OF IMPUL-
SIVE DELTA V AT YIG
FOR PC ALONG VXR.
IN FPS TO NEAREST
.1 FPS.

DELTA VZ(LV) -
COMPONENT OF IMPUL-
SIVE DELTA V AT
TIG FOR PC ALONG -R.
IN FPS TO NEAREST
.1 FPS.

WHERE R IS CSM GEO-
CENTRIC RADIUS VEC-
TOR AND V IS CSM
INERTIAL VELOCITY
AT TIG FOR PC

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH JPN
RECEIPT OF PROCEED
OR NEW DATA.

```

• PRJCEED      • NEW
•              • DATA
•              •
•              •
•              •
•              •
•              •
•              •
•              •

```

AM I SATISFIED WITH THESE VALUES?

.Y	
.	RECORD THESE
.	VALUES
.	
.	
.	
.	

KEY IN PRICED

KEY IN V22 AND
LOAD DESIRED
DELTA V VALUE.
NOTE: OVERWRITING
R1, R2, R3 WITH 0
DURING MINKEY
SEQUENCE WILL
CAUSE ENTRANCE
INTO P52 FOLLOW-
ING P38 TO BE
BYPASSED
IF N91 = 0,0,0
EITHER VIA THE

#210

#280

#290

\$300

315

#320

#330

#340

#350

#360

DSKY OR MINKEY
SEQUENCE A 01301
ALARM
[ARC SINE - ARC
COSINE ARGUMENT
TOO LARGE) MAY
RESULT.

IS FINAL FLAG SET?

.N .Y

SET MGA DISPLAY
IN R3 (BELOW) =
-00001

IS REFSMMAT
FLAG SET?

.Y .N

COMPUTE IMU
MIDDLE GIM-
BAL ANGLE
AT TIG(PC)
FOR THE
PRESENT
IMU ORIEN-
TATION WITH
THE CSM +X
AXIS ALIGNED
WITH THE
INITIAL
THRUST
VECTOR

SET MGA
DISPLAY

#420

#430

#440

#450

#460

+ AFTER TIG(PC).

MGA-MIDDLE GIMBAL
ANGLE AT TIG(PC) IF
C.SM +X AXIS IS
ALIGNED WITH INITIAL
THRUST DIRECTION.
IN DEGREES TO NEAR-
EST .01 DEGREE.
SIGN IS ALWAYS +
EXCEPT:

(A) WHEN DISPLAYED
AT ANY TIME OTHER
THAN THE LAST PASS
THROUGH THE PROGRAM
THE VALUE IS -00001.

(B) ON THE LAST PASS
WHEN THE IMU IS NOT
ALIGNED THE VALUE IS
-00002.

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

.PROCEED .RECYCLE

GO TO

KEY IN RECYCLE
V32E

GO TO

"A"
ABOVE

"A"
ABOVE

#470

IS FINAL FLAG SET?

.Y .N

SET FINAL
FLAG

#480

GO TO
"A"
ABOVE

#490

IS THIS MINKEY?
(IS AUTOSEQ FLAG
SET?)

.Y .N

CHANGE W-MATRIX
REINITIALI-
ZATION VALJES
TO 2000 F,
2 FPS.

#500

DO ROUTINE R00

DO ROUTINE R00

#510

SPS PROGRAM (P40)

REV 01 03/20/72

PURPOSE:

- (1) TO COMPUTE A PREFERRED IMU ORIENTATION AND A PREFERRED VEHICLE ATTITUDE FOR A SPS THRUSTING MANEUVER.
- (2) TO CALCULATE AND DISPLAY THE GIMBAL ANGLES WHICH WOULD RESULT WITH THE PRESENT IMU ORIENTATION IF THE VEHICLE WERE MANEUVERED TO THE PREFERRED VEHICLE ATTITUDE FOR A SPS THRUSTING MANEUVER. THE CREW IS THEREBY GIVEN AN OPPORTUNITY TO PERFORM THE MANEUVER WITH:

(A) THE PRESENT IMU ORIENTATION, IF THE MIDDLE GIMBAL ANGLE IS NOT GREATER THAN 45 DEGREES, AND THE IMU HAS BEEN ALIGNED WITHIN THE LAST 3 HRS.

(B) A NEW ORIENTATION ACHIEVED BY SELECTION OF P52.

- (3) TO DO THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

- (4) TO CONTROL THE GNCS DURING COUNTDOWN, IGNITION, THRUSTING, AND THRUST TERMINATION OF A GNCS CONTROLLED SP9 MANEUVER.

ASSUMPTIONS: (1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE CMC BY PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIRED STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRE-THRUST PROGRAM, WHICH EITHER SET OR RESET THE EXTERNAL DELTA V STEERING FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER BOTH DURING THRUSTING AND UNTIL THE CREW NOTIFIES THE CMC TRIM THRUSTING HAS BEEN COMPLETED THE CMC UPDATES VG ONLY AS A RESULT OF COMPENSATED ACCELEROMETER INPUTS.

FOR LAMBERT STEERING VG IS CALCULATED AND UPDATED SIMILARLY, HOWEVER IT IS ALSO UPDATED PERIODICALLY BY LAMBERT SOLUTIONS TO CORRECT FOR CHANGES IN THE CSM STATE VECTOR.

- (3) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

- (4) THE TTE CLOCK IS SET TO COUNT TO ZERO AT TIG.

- (5) ENGINE IGNITION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF INTEGRATION CAN NOT BE COMPLETED ON TIME.

(6) THE SPS THRUSTING PROGRAM DOES NOT MONITOR THE SC CONTROL DISCRETE (CHANNEL 31 BIT 15) DURING THRUSTING. THIS MEANS THAT THE CMC WILL CONTINUE TO GENERATE ENGINE ACTUATOR COMMANDS, SPS ENGINE ON DISCRETE, AND FDAI ATTITUDE ERROR NEEDLE COMMANDS UNTIL THE CMC SOLUTION INDICATES ENGINE OFF AT WHICH TIME THESE COMMANDS AND THE ENGINE ON DISCRETE ARE TERMINATED. HOWEVER, THIS PROGRAM IS NOT WRITTEN TO TAKE INTO ACCOUNT THE SITUATION WHERE CONTROL MAY BE TAKEN AWAY FROM THE GNCS AND THEN GIVEN BACK, AND IT IS NOT RECOMMENDED. IN EVENT CONTROL IS TAKEN AWAY FROM THE GNCS, THE CMC WILL ONLY BE RESPONSIBLE FOR COMPUTATION OF POSITION AND VELOCITY.

- (7) ROUTINE R03 HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. IN ORDER FOR THE GNCS TO PERFORM THE ATTITUDE MANEUVER AND CONTROL THE THRUSTING MANEUVER THE ASTRONAUT MUST KEY IN V46E AT SOME TIME PRIOR TO THE ATTITUDE MANEUVER.

- (8) P40 SHOULD NOT BE PERFORMED IN THE CSM-DWS DOCKED CONFIGURATION.

(9) THE VALUE OF DELTA V REQUIRED WILL BE STORED IN THE LOCAL VERTICAL COORDINATE SYSTEM AND IS AVAILABLE DURING THIS PROGRAM UNTIL AVERAGE G TURN ON BY KEYING IN V06N81.

- (10) THE ORBITAL PARAMETERS DISPLAY ROUTINE (R30) MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

(411) THE CMC ISSUES AN SIV-B CUTOFF COMMAND (CHANNEL 12 BIT 14) FOR POSSIBLE BACK-JP USE. THIS SIGNAL IS RECOGNIZED BY SATURN ONLY IF THE LAUNCH VEHICLE GUIDANCE SWITCH IS SET TO CMC.

(12) THE ASTRONAUT MAY REQUEST A TFI DISPLAY (AVAILABLE UNTIL ENTRY INTO TVC DAP) BY KEYING IN EITHER VL6N40 FOR MINS-SECS (R1), OR VL6N35 FOR HRS (R1), MINS (R2), AND SECS (R3).

(13) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY THE MINKEY CONTROLLER (R37).

PRNG
CONT

CMC

GRUND

CREW

- AUTOMATIC
- PROGRAM
- SELECTION

• CREW PROG.
• SELECTION

• • • • •

• • • • •

000 R00 TO START SPS
PROGRAM (P40)
DISPLAY PROGRAM 40

KEY IN SPS
PROGRAM (P40)
V37E 40E

#10

#20

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 40

SET SBFLAG

#30

IS EXTERNAL DELTA V
FLAG SET?

• N • Y

SET CSTEER = 1
IN STEER LAW

SET CSTEER=0
IN STEER LAW

DO IMU STATUS CHECK
ROUTINE (R02)

COMPUTE INITIAL
THRUST DIRECTION AND
INITIAL VALUE OF VG
VECTOR AND STORE IN
N81 (VG LOCAL VERT-
ICAL)

#40

#50

#60

#70

#80

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. .
. .
. .
. .
. .

FROM INITIAL THRUST
DIRECTION AND ENGINE
BELL TRIM ANGLES
COMPUTE PREFERRED
IMU ORIENTATION:

X = UNIT (X)
-SM -CSM
Y = UNIT (X X R)
-SM -CSM -
Z =UNIT (X X Y)
-SM -SM -SM

#90

WHERE:
X = THE CSM X AXIS
-CSM AT IGNITION
(AT THE PRE-
FERRED VE-
HICLE ATTI-
TUDE)

#100

R = THE CSM POS-
- ITION RADIUS
VECTOR AT TIG.

#110

.
. .
. .
. .
. .
. .

STORE DESIRED ATTI-
TUDE SPECIFICATION
(TRIMMED ENGINE BELL
CENTER LINE IN DI-
RECTION OF INITIAL
THRUST) FOR USE BY
ATTITUDE MANEUVER
ROUTINE (R60). THE
FINAL ATTITUDE WILL

#120

.....
SNAP .

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM ENGINE GIMBAL
DRIVE TEST ENABLE
V50 N25
R1-00204
R2-BLANK
R3-BLANK

MONITOR DSKY
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM
ENGINE GIMBAL DRIVE
TEST ENABLE

#180

1

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR ENTER

•ENTER •PROCEED

- INITIALIZE ENGINE
- GIMBALS TO 0
- DEGREES IN PITCH
- AND YAW AND PER-
- FORM GIMBAL DRIVE
- TEST SEQUENCE AT
- 2 SEC/STEP:

	PITCH	YAW
1	2	0
2	-2	0
3	0	0
4	0	2
5	0	-2

MONITOR GIMBAL DRIVE
SEQUENCE BY REFER-
ENCE TO ANALOG DIALS

#210

#220

258

6 J / 0
IN DEGREES.

WAIT 4 SECONDS

DRIVE SPS ENGINE
BELL TO TRIM PO-
SITION

DISPLAY ON DSKY:
V06 N40
R1 - YFI
R2 - VG
R3 - DELTA VM

TFI - TIME FROM
SPS IGNITION. IN
MIN, SEC TO NEAR-
EST SEC. MAX
READING IS 59B59.
(SIGN IS - BEFORE
NOMINAL TIG, +
THEREAFTER).

VC - MAGNITUDE OF THE
VELOCITY TO BE
GAINED BY THRUSTING
MANEUVER. IN FPS
TO NEAREST .1 FPS

TEMP
HOLD
...
MCN

OBSCURE DIAL INDICATION OF ENGINE BELL DRIVING TO TRIM POSITION

MONITOR DSKY:
OBSERVE DISPLAY OF
TFI, VG, AND DELTA
VM

#230

042#

#250

#260

#270

DELTA V4-MEASURED
DELTA V MAGNITUDE
IN FPS TO NEAREST
.1 FPS. THIS DIS-
PLAY SHOULD BE
C0000 UNTIL AVER-
AGE-G IS STARTED.

.
.
.

SET TOEC = TIG
-30 SEC

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.
.
.
.
.
.

DO STATE VECTOR
INTEGRATION (MID TO
AVE) ROUTINE (R41).

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.
.
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.
.

WAIT UNTIL TFI =
-35 SEC

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.
.

BLANK DISPLAY OF
VERB-NCJN AND R1,
R2, R3 AT TFI = -35

.
.....
.

.
.....
.

DO STATE VECTOR
INTEGRATION (MID TO
AVE) ROUTINE (R41).
OBSERVE THAT THE
COMPUTER ACTIVITY
LIGHT IS ON UNTIL
COMPLETION OF
ROUTINE 41

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.
.
.
.
.
.
.

MONITOR DSKY:
OBSERVE THAT DISPLAY
GOES BLANK

#280

#290

#300

#310

AT TFI = -35 SEC

• • •

WAIT UNTIL TFI =
-30 SEC

• • • •

RESET PREFERRED
ORIENTATION FLAG

...

REDISPLAY VO6N40 NON-
FLASHING AND CALL
AVERAGE G ROUTINE.

[illegible]

• • • • •

• • • • •

WAIT UNTIL
TFI ==5 SEC

• • • • •

• • • • •

MONITOR DSKY:
OBSERVE REDISPLAY OF
TFI, VG, DELTA VM,
AT TFI = -30 SEC.
TO INDICATE THAT THE
AVERAGE G ROUTINE IS
TURNED ON. OBSERVE
THAT THE COMPUTER
ACTIVITY LIGHT
BLINKS ON EVERY 2
SECONDS DURING
AVERAGE G.

• • • • •

MONITOR DSKY:
IN THE PERIOD FROM
TFI --30 SEC UNTIL
TFI --25 SEC
DOES DELTA VM BECOME
GREATER THAN 2.0 FPS
INDICATING EXCESSIVE

#320

#330

04E#

#350

#360

15

#510

#520

0530

#540

#550

#560

#570

085

065#

\$600

292

ALARM LIGHT AND
STORE ALARM CODE
1407.

.THRUST "THRUST
-OK "FAILURE"

DO THE SPS THRUST
FAIL ROUTINE
(R40).

TEMP
HOLD
MON

CHANGE IFI DISPLAY
TO TFC IN R1
V06 N40
R1 - TFC
R2 - VG
R3 - DELTA VM

TFC - TIME FROM
ENGINE CUTOFF.
IN MIN AND SEC TO
NEAREST SEC.
MINUS BEFORE CUTOFF

DO THE SPS
THRUST FAIL
ROUTINE (R40)

MONITOR DSKY:
OBSERVE CHANGE OF
TFI DISPLAY TO TFC
IN R1

MONITOR SPS
THRUSTING:
1. DSKY:
R1-TFC
SHOULD BE
DECREASING

#660

#670

#680

#690

#700

R2-VG SHOULD BE
DECREASING

R3-DELTA VM
SHOULD INCREASE

2. FDI-ATT. ERROR
SHOULD BE LESS THAN
OR EQUAL TO --DEGREE
ATT RATES SHOULD BE
LESS THAN OR EQUAL
TO -- DEGREE/SEC.

3. SPS CHAMBER
PRESSURE (PC)
SHOULD BE NORMAL

Y. .N

MONITOR DSKY:
AS TFC AND VG GO
TO ZERO THRUST
SHOULD CUTOFF.

.N .L
.O .A
.R .T
.M .E
.A .L
.L .

GO TO
BACKUP
PROCEDURES

#710

#720

#730

#740

#750

CMC TERMINATES EN-
GINE ON COMMAND WHEN
INDICATED BY CROSS
PRODUCT STEERING,
COMPLEX IMPULSIVE
BURN ROUTINE (AS
DESCRIBED IN SECTION
5.3) OR IMPULSIVE
THRUST TIMER (SET UP
AT IGNITION AS
DEFINED IN SECTION
5.3 OF R693)

#760

#770

WAIT ABOUT 2.5
SECONDS

#780

SET WIDE DEADBAND
IN RCS OAP

TURN OFF TVC
OAP AND DIS-
ABLE TVC IN-
TERFACE

#790

270

271

307
P40/SKYLARK

.....

FREEZE TFC
AT CURRENT
VALVE (WILL
NORMALLY
SHOW +2
SECONDS)

#800

.....

WAIT ABOUT
0.6 SEC

#810

.....

TURN RCS DAP ON
AND WAIT ABOUT 1 SEC
FOR JET FIRINGS.

#820

.....

MOVE MAIN PANEL
DELTA V THRUST
NORMAL A+B
SWITCHES TO OFF.

#830

.....

MAINTAIN VG
COMPUTATIONS AFTER
CUTOFF FOR POSSIBLE
NULLING BY RCS
TRIMMING MANEUVER

#840

P40/SKYLARK

#850

HOLD
MON

FLASH VERB-NOUN TO
REQUEST PROCEED.
V16 N40
R1 - TFC
R2 - VG
R3 - DELTA VM

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PROCEED AND DISPLAY
OF TFC, VG AND DELTA
VM.

#860

WAIT FOR KEYBOARD
ENTRY

#870

KEY IN PROCEED

#880

TERMINATE FLASH UPON
RECEIPT OF PROCEED.

P
R
O
C
E
E
D

#890

046#

KEY IN PROCEED

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED

உ ஈ ஓ வ ய ற ற

#950

0960

TRANSMIT ORBITAL.....RECEIVE ORBITAL DATA
DATA TO CREW . FROM GROUND

0161

DO ROUTINE ROO

DO ROUTINE ROO

EXIT

Exit

CHANGE CONTROL VOTES

REV 00 PCR 003,011,040, PCN 457, SKYLARK MEMO #20
REV 01 PCN 489

RCS PROGRAM (P41)

REV 01 03/20/72

PURPOSE:

(1) TO COMPUTE A PREFERRED IMU ORIENTATION AND A PREFERRED VEHICLE ATTITUDE FOR AN RCS THRUSTING MANEUVER.

(2) TO CALCULATE THE GIMBAL ANGLES WHICH WOULD RESULT WITH THE PRESENT IMU ORIENTATION IF THE VEHICLE X-Y-Z AXIS WERE ALIGNED TO THE THRUST VECTOR. THE CREW IS THEREBY GIVEN AN OPPORTUNITY TO PERFORM THE MANEUVER WITH:

(A) THE PRESENT IMU ORIENTATION (NOT RECOMMENDED IF MIDDLE GIMBAL ANGLE IS GREATER THAN 45 DEGREES). IF THE IMU HAS NOT BEEN ALIGNED WITHIN THE LAST 3 HRS, REALIGNMENT IS DESIRABLE.

(B) A NEW ORIENTATION ACHIEVED BY SELECTION OF P52.

(3) TO DO THE VEHICLE MANEUVER TO THE THRUSTING ATTITUDE.

(4) TO PROVIDE SUITABLE DISPLAYS FOR MANUAL EXECUTION OF THE THRUSTING MANEUVER.

ASSUMPTIONS:

(1) THE TARGET PARAMETERS HAVE BEEN CALCULATED AND STORED IN THE CMC 3Y PRIOR EXECUTION OF A PRE-THRUSTING PROGRAM.

(2) THE REQUIRED STEERING EQUATIONS ARE IDENTIFIED BY THE PRIOR PRETHRUST PROGRAM, WHICH EITHER SET OR RESET THE EXTERNAL DELTA V STEERING FLAG. FOR EXTERNAL DELTA V STEERING, VG IS CALCULATED ONCE FOR THE SPECIFIED TIME OF IGNITION. THEREAFTER BOTH DURING THRUSTING AND UNTIL THE CREW NOTIFIES THE CMC TRIM THRUSTING HAS BEEN COMPLETED, THE CMC UPDATES VG ONLY AS A RESULT OF COMPENSATED ACCELEROMETER INPUTS.

FOR LAMBERT STEERING VG IS CALCULATED AND UPDATED SIMILARLY, HOWEVER IT IS ALSO UPDATED PERIODICALLY BY LAMBERT SOLUTIONS TO CORRECT FOR CHANGES IN THE CSM STATE VECTOR.

(3) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

(4) THE TTE CLOCK IS SET TO COUNT TO ZERO AT TIG.

(5) TRANSLATION INITIATION MAY BE SLIPPED BEYOND THE ESTABLISHED TIG IF DESIRED BY THE CREW OR IF INTEGRATION CAN NOT BE COMPLETED ON TIME.

(6) ROUTINE R03 (R04 IF CSM-OWS DOCKED) HAS BEEN PERFORMED PRIOR TO SELECTION OF THIS PROGRAM. IN ORDER FOR THE GNCS TO PERFORM THE ATTITUDE MANEUVER AND MAINTAIN ATTITUDE CONTROL THE ASTRONAUT MUST KEY IN V46E (V45E IF CSM-OWS DOCKED) AT SOME TIME PRIOR TO THE ATTITUDE MANEUVER.

(7) THE VALUE OF DELTA V REQUIRED AT TIG IN LOCAL VERTICAL COORDINATES IS STORED IN NOUN 81 AND MAY BE CALLED UNTIL AVERAGE G IS TURNED ON BY KEYING IN V06N31E.

(8) THE ORBITAL PARAMETERS DISPLAY ROUTINE (R30) MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

(9) THE ASTRONAUT MAY REQUEST A TFI DISPLAY BY KEYING IN EITHER V16N40 FOR MINS-SECS (R1), OR V16N35 FOR HRS (R1), MINS (R2), AND SECS (R3).

(10) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY MINKEY CONTROLLER (R07).

PRG

CMC

GROUND

CREW

CONT

•AUTOMATIC
•PROGRAM
•SELECTION
.
.
...

DO R00 TO START RCS
PROGRAM (P41)
DISPLAY PROGRAM 41

•CREW PROG.
•SELECTION
.
.
...

KEY IN RCS PROGRAM
(P41)
V37E 41E

#10

.....
.
.....

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 41

#20

..
.

SET CSTEER = 0.

..
..
.

DO IMU STATUS CHECK
ROUTINE (R02)

#30

.....
.
.....

DO IMU STATUS CHECK
ROUTINE (R02)

#40

..
..
.

COMPUTE INITIAL
THRUST DIRECTION AND
INITIAL VALUE OF VG
VECTOR AND STORE IN

NOUN 81 (VG LOCAL
VERTICAL)

•
•
•
•

#50

COMPUTE PREFERRED
IMU ORIENTATION:

X = UNIT (T)
-SM -

#60

Y = UNIT (X X R)
-SM -

Z = UNIT (X X Y)
-SM -SM -SM

WHERE:

T = INITIAL THRUST
- VECTOR

#70

R = THE CSM POSITION
- RADIUS VECTOR AT
TIG

•
•
•
•

#80

STORE DESIRED ATTIT-
UDE SPECIFICATION
FOR USE BY ATTITUDE
MANEUVER ROUTINE
(R60). THE FINAL
ATTITUDE WILL BE
COMPUTED DURING R60
AND WILL POINT THE
+X TRANSLATION AXIS
IN THE INITIAL
THRUST DIRECTION.

#90

HOWEVER, IN ORDER TO
CONSERVE RCS FUEL
AND NOT CONSTRAIN
THE NONCRITICAL ROLL
ATTITUDE, WINGS MAY
NOT BE LEVEL IN THE
COMPUTED FINAL
ATTITUDE.

#100

• • •

SFT PREFERRED
ORIENTATION FLAG

...

#110

IS DOCKED DAP RUNNING?

$$\begin{array}{c} y \\ \bullet \quad \bullet \quad \bullet \\ \\ z \\ \bullet \quad \bullet \quad \bullet \end{array}$$

- SET DOCKED
- DEADBAND INTO
- DOCKED DAP

#120

**SET MINIMUM
DEADBAND IN RCS DAP**

#130

#140

RESET 3AXISFLG

• • • • •

DO ATTITUDE MANEUVER
ROUTINE (R60)

.....
.....

#150

++

+C1

TEMP

HOLD

.....

MON

+

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+

DISPLAY (NO FLASH)

V06N85

R1 VGX(CONT)

R2 VGY(CONT)

R3 VGZ(CONT)

VGX(CONT), VGY(CONT)

VGZ(CONT) - COMPO-

NENTS OF THE VG

VECTOR AT TIG RE-

SOLVED ALONG PRESENT

CSM X, Y, AND Z CON-

TROL AXES RESPECT-

IVELY. UPDATED M.R.T.

VEHICLE ATTITUDE

EVERY 1 SECOND IN

FPS TO NEAREST .1

FPS.

MONITOR DSKY:

OBSERVE NON-

FLASHING VERB-NOUN

DISPLAY OF VG COM-

PONENTS.

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SELECT A/P AND MODE

CONTROL AS DESIRED.

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DO STATE VECTOR IN-

TEGRATION (MID TO

AVE) ROUTINE (R41).

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.....

DO STATE VECTOR IN-

TEGRATION (MID TO

AVE) ROUTINE (R41).

OBSERVE THAT THE

COMPUTER ACTIVITY

LIGHT IS ON UNTIL

.....

.....

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.....

.....

COMPLETION OF
ROUTINE 41.

#200

WAIT UNTIL TFI =
- 35 SEC

#210

BLANK DISPLAY OF
VERB-NOUN AND RL,
R2, R3 AT TFI =-35
SEC.

MONITOR DSKY:
OBSERVE THAT DISPLAY
GOES BLANK AT TFI =
- 35 SEC.

#220

WAIT UNTIL TFI =
-30 SEC

RESET PREFERRED
ORIENTATION FLAG

#230

CALL AVERAGE G
INTEGRATION AND
VG UPDATE (IN-
STANTANEOUS VG
VECTOR).

#240

THRUST MONITOR PROGRAM (P47) REV 01 03/20/72

PURPOSE:

- (1) TO MONITOR VEHICLE ACCELERATION DURING A NON GNCS CONTROLLED THRUSTING MANEUVER.
- (2) TO DISPLAY THE DELTA V APPLIED TO THE VEHICLE BY THIS THRUSTING MANEUVER.

ASSUMPTIONS:

- (1) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.
- (2) THE RESPONSIBILITY OF AVOIDING GIMBAL LOCK DURING EXECUTION OF THIS PROGRAM IS UPON THE ASTRONAUT.
- (3) THIS PROGRAM IS NORMALLY USED DURING RENDEZVOUS FINAL PHASE. IF THE CREW DESIRED TO DO ANY FINAL PHASE THRUSTING MANEUVERS AUTOMATICALLY UNDER GNCS CONTROL THEY MUST BE ACCOMPLISHED VIA SELECTION OF THE TPI TARGETING PROGRAM (P35) AND THEN THE SPS THRUSTING PROGRAM (P40) OR THE RCS THRUSTING PROGRAM (P41).
- (4) RANGE, RANGE RATE, AND THETA MAY BE DISPLAYED DURING THIS PROGRAM BY CALLING THE RENDEZVOUS PARAMETER DISPLAY NO 1 ROUTINE (R31) WITH V83E.
- (5) RANGE, RANGE RATE, AND PHI MAY BE DISPLAYED DURING THIS PROGRAM BY CALLING THE RENDEZVOUS PARAMETER DISPLAY NO 2 ROUTINE (R34) WITH V85E.
- (6) VI, HDOT, AND H MAY BE CALLED BY KEYING IN V16N62E.
- (7) THE ORBITAL PARAMETERS DISPLAY ROUTINE MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.
- (8) THIS PROGRAM SHOULD BE TURNED ON JUST PRIOR TO THE PLANNED THRUSTING MANEUVER AND TERMINATED AS SOON AS POSSIBLE FOLLOWING THE MANEUVER IN ORDER TO KEEP IMU COMPENSATION AND AVERAGE G COMPUTATION ERRORS AT A MINIMUM.
- (9) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG
CONT

CMC	GRJND	CREW
		.CREW
		.
		.PROGRAM
		.SELECTION
		.
		...

DO NOT TO START
THRUST MONITOR
PROGRAM (P47).
DISPLAY P47.

KEY IN THRUST
MONITOR PROGRAM
(P47)
V37E47E

#20

#30

040

050

60

P47/SKYLARK

DELTA VX (CONT)-COM-
PONENT OF INTEGRATED
ACCELERATION ALONG
CSM CONTROL +X AXIS.
IN FPS TO NEAREST
.1 FPS.

DELTA VY (CONT)-COM-
PONENT OF INTEGRATED
ACCELERATION ALONG
CSM CONTROL +Y AXIS.
IN FPS TO NEAREST
.1 FPS.

DELTA VZ (CONT)-COM-
PONENT OF INTEGRATED
ACCELERATION ALONG
CSM CONTROL +Z AXIS.
IN FPS TO NEAREST .1
FPS.

NOTE1: R1,R2, AND R3
WILL READ 0000 IN-
ITALLY AND WILL RE-
MAIN SC (EXCEPT FOR
ACCELEROMETER BIASES)
UNTIL A THRUSTING
MANEUVER IS STARTED.
THEY WILL BE UPDATED
EVERY 2 SEC.

NOTE2: IN THE EVENT
THIS PROGRAM IS USED
TO MONITOR MANEUVERS
WITH A DELTA V
GREATER THAN 9999.9
FPS THIS DISPLAY
WILL ONLY LOSE THE
HIGH ORDER DIGIT. IT
WILL OTHERWISE READ
CORRECTLY.

PERFORM THRUSTING
MANEUVER AS DESIRED
MONITOR FDI1 BALL
TO AVOID GIMBAL
LOCK

#70

#80

#90

#100

#110

#120

#130

#140

#150

WAIT FOR KEYBOARD
ENTRY

SHALL I ZERO
THE DISPLAY IN
ORDER TO MONI-
TOR ANOTHER
BURN?

.N
.Y

KEY
IN
RE-
CYCLE
V32E

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

.RECYCLE .PROCEED

REINITIAL-
IZE ACCEL-

KEY IN PROCEED

287

327
P47/SKYLARK

EROMETER
INTEGRA-
TION

#160

#170

DO ROUTINE R00

EXIT P47

CHANGE CONTROL NOTES

REV 00 SKYLARK MEMO #2
REV 01 PCN 489

P47/SKYLARK

PRECEDING PAGE BLANK NOT FILMED

RENDEZVOUS THRUST MONITOR PROGRAM (P48)

REV 01 03/20/72

PURPOSE:

- ++
 - +01
 - +459
 - ++
- (1) TO DISPLAY TO THE ASTRONAUT RANGE AND RANGE RATE FROM A SOURCE INDEPENDENT OF VEHICLE STATE VECTORS.
 - (2) TO DISPLAY CMC CALCULATED PARAMETER THETA.
 - (3) TO ALLOW THE ASTRONAUT TO SELECT A FOUR - MINUTE SEQUENCE OF TIMES FOR WHICH THE RANGE RATE WILL BE OPTIMIZED.
 - (4) TO MONITOR VEHICLE ACCELERATION DURING A NON-GNCS CONTROLLED THRUSTING MANEUVER.
 - (5) TO DISPLAY THE DELTA V APPLIED TO THE VEHICLE BY THIS THRUSTING MANEUVER.

ASSUMPTIONS:

- (1) THE VHF MUST BE OPERATING.

- (2) IT IS NORMALLY REQUIRED THAT THE ISS BE ON FOR 15 MINUTES PRIOR TO A THRUSTING MANEUVER.

- (3) THE RESPONSIBILITY OF AVOIDING GIMBAL LOCK DURING EXECUTION OF THIS PROGRAM IS UPON THE ASTRONAUT.

- (4) RANGE, RANGE RATE, AND PHI (COMPUTED FROM STATE VECTORS) MAY BE DISPLAYED BY CALLING R34 WITH V85E.

- (5) THE ORBIT PARAMETER DISPLAY ROUTINE MAY BE CALLED DURING THIS PROGRAM BY KEYING IN V82E.

- (6) THIS PROGRAM IS NORMALLY USED DURING RENDEZVOUS FINAL PHASE.

- (7) THIS PROGRAM SHOULD BE TURNED ON A FEW MINUTES PRIOR TO THE PLANNED THRUSTING MANEUVER (TO ALLOW R27 CONVERGENCE) AND TERMINATED AS SOON AS POSSIBLE FOLLOWING THE MANEUVER IN ORDER TO KEEP IMJ COMPENSATION AND AVERAGE G COMPUTATION ERRORS AT A MINIMUM.

- (8) +X OR -X TRANSLATION IS ASSUMED TO OCCUR ONLY ALONG THE LINE-OF-SIGHT TO THE DWS.

- (9) NO +X OR -X TRANSLATION SHOULD BE PERFORMED DURING AN OPTIMIZATION.

- (10) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY OR INTERNALLY BY MINKEY CONTROLLER (R07).

++

+C1

+

+489

++

PROG
CONT

CMC

GROUND

CREW

- AUTOMATIC
- PROGRAM
- SELECTION

- CREW
- PROGRAM
- SELECTION

-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-
-

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#10

KEY IN RENDEZVOUS
THRUST MONITOR
PROGRAM (P48).
V37E48E

#20

MONITOR DSKY:
OBSERVE DISPLAY
OF PROGRAM 48.

#30

NOTE: THE TIME OF
OPTIMIZATION MAY BE
CHANGED IN P48 ONLY
BY KEYING V25N72E
AND LOADING THE
DESIRED TIME

#40

#50

DO IMU STATUS
CHECK ROUTINE
(R02)

.....

.....

#60

DO STATE VECTOR
INTEGRATION (MID TO
AVE) ROUTINE (R41).
OBSERVE THAT THE
COMPUTER ACTIVITY
LIGHT IS ON UNTIL
THE COMPLETION OF
ROUTINE 41.

.....

DO STATE VECTOR
INTEGRATION (MID TO
AVE) ROUTINE (R41).

.....

#70

CALCULATE TED
FOR POSSIBLE DISPLAY
IN N76.

.....

#80

CALL AVERAGE-G
ROUTINE

.....

IS CYCLFLAG SFT?

N. Y

#90

CALL VHF RANGE
RATE MARK PRO-
CESSING ROUTINE
(R27)

THE VHF RANGE RATE
MARK PROCESSING
ROUTINE IS NOW
RUNNING. RANGE AND
RANGE RATE DATA ARE
FROM VHF ONLY. THEY
ARE INDEPENDENT OF
THE STATE VECTORS.

#100

.....

.....

P48/SKYLARK

SECOND).

+

ARE BEING OPTIMIZED.
OTHERWISE RANGE,
RANGE RATE ARE
CURRENT VALUES.

TFO - TIME FROM
NOW TO OPTIMIZATION
TIME (INT2) IN MIN
AND SEC TO NEAREST
SEC. THE VALUE IS
+59859 IF NO
OPTIMIZATION WAS
REQUESTED.

DO I WANT TO ALTER
THE PRESENT N72
TIME?

☐ NO ☐ YES

WAIT FOR KEYBOARD
ENTRY

WHEN FINISHED
WITH DISPLAY
KEY IN PROCEED
NOTE: NEXT
DISPLAY NOT
VALID UNTIL
TFD = +00B02

KEY IN V25N72E
AND LOAD
DESIRED N72
TIME.

TERMINATE FLASH UPON
RECEIPT OF RECYCLE
OR PROCEED

α β γ
α β γ

WHEN FINISHED
WITH DISPLAY KEY
IN RECYCLE V32E

#210

#220

#230

#240

#250

HOLD
MON

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY RENDEZVOUS
PARAMETERS:
V16 N77
R1 - RANGE
R2 - RANGE RATE
R3 - THETA
RANGE - VHF RANGE
TO SKYLAB IN NAUTI-
CAL MILES TO
NEAREST .01 NM.
RANGE RATE - RANGE
RATE BETWEEN CSM AND
SKYLAB CALCULATED
(AND OPTIMIZED TO
N72 TIME IF IN
OPTIMIZATION OPTION)
BY VHF RANGE RATE
FILTER. IN FPS TO
NEAREST .1 FPS
NEGATIVE SIGN INDI-
CATES CLOSING.
THETA - ANGLE BE-
TWEEN CSM +X AXIS
AND THE LOCAL
HORIZONTAL PLANE.
FROM 0 TO 360 DEG-
REES. IN DEGREES TO
NEAREST .01 DEGREE.
NOTE: IF R27
OPT = 0, RANGE,
MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF RANGE, RANGE
RATE, AND THETA.
NOTE: RANGE RATE
OPTIMIZATION IS DIS-
CUSSED IN GSOP
SECTION 5, R27.
PERFORM +X OR -X
TRANSLATION ONLY
WHEN COAS IS BORE-
SIGHTED; PERFORM
Y OR Z TRANSLATION
AS DESIRED

RANGE RATE AND THETA
ARE CURRENT VALUES.
IF R27 OPT NOT 0:

TFD < -01B35 RANGE,
RANGE RATE ARE
CURRENT VALUES;

-01B35 < TFD <
+00B02 RANGE,
RANGE RATE FIXED
AT LAST CURRENT
VALUE;

+00B02 < TFD <
+01B35 RANGE,
RANGE RATE ARE
OPTIMIZING VALUES;

TFD < -00R20:
THETA IS CURRENT
VALUE;

-00R20 < TFD
< +00B02: THETA =
-00001

TFD > +00B02:
THETA IS OPTIMIZED
VALUE.

DO I WANT TO ALTER
THE PRESENT N72
TIME?

NO YES

WAIT FOR KEYBOARD
ENTRY

WHEN FINISHED
WITH DISPLAY
KEY IN PROCEED

#260

#270

#280

#290

#300

DELTA VY(CONT)-COM-
PCNENT OF INTEGRATED

**WHEN FINISHED
WITH DISPLAY KEY
IN RECYCLE V32E**

MONITOR DSKY:

VERB-NOUN TO REQUEST
RESPONSE AND DISPLAY
OF EACH COMPONENT OF
DELTA V(CONT).

ACCELERATION ALONG
CSM CONTROL +Y AXIS.
IN FPS TO NEAREST
.1 FPS.

DELTA VZ(CONT)-COM-
PONENT JF INTEGRATED
ACCELERATION ALONG
CSM CONTROL +Z AXIS.
IN FPS TO NEAREST .1
FPS.

NOTE: R1, R2, AND R3
WILL READ 00000 IN-
ITIALY AND WILL RE-
MAIN SO (EXCEPT FOR
ACCELEROMETER BIASES)
UNTIL A THRUSTING
MANEUVER IS STARTED.
THEY WILL BE UPDATED
EVERY 2 SEC.

.....
.
.
.

WAIT FOR KEYBOARD
ENTRY

PERFORM +X OR -X
TRANSLATION ONLY
WHEN COAS IS BORE-
SIGHTED; PERFORM
Y OR Z TRANSLATION
AS DESIRED

SHALL I TERMINATE
THIS PROGRAM?

.Y .N

SHALL I ZERO
THE DELTA V
DISPLAY?

.N .Y

KEY IN
RECYCLE
V32E.

#350

#360

#370

#380

#390

#400

#410

#420

#430

MONITOR R27
DATA BY
ASTRONAUT
CALL IF
DESIRED.

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

RECYCLE PROCEED

DO ROUTINE R00

EXIT
P48

CHANGE CONTROL NOTES

REV 00 PCR 025,032, SKYLARK MEMDS #3,19
REV 01 PCR 459, PCN 489

ATM ORIENTATION DETERMINATION PROGRAM (P50)

REV 01 03/20/72

PURPOSE:

(1) TO COMPUTE AND STORE THE ORIENTATION OF THE APOLLO TELESCOPE MOUNT SENSOR COORDINATE SYSTEM WITH RESPECT TO THE NAVIGATION BASE COORDINATE SYSTEM.

(2) TO COMPUTE AND DISPLAY THE DOCKING ANGLES CORRESPONDING TO THIS ORIENTATION.

ASSUMPTIONS:

(1) THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY.

(2) THE +Z AXIS OF THE ATM SENSOR COORDINATE SYSTEM POINTS IN THE SAME DIRECTION AS THE SUN SENSOR. THE -Y AXIS OF THE ATM SENSOR COORDINATE SYSTEM POINTS IN THE SAME DIRECTION AS THE STAR TRACKER WHEN STAR TRACKER GIMBAL ANGLES ARE ZERO.

(3) THREE OPTIONS ARE AVAILABLE:

(A) OPTION 1 - ATM SUN SENSOR AND IMU ORIENTATION ARE USED TO DETERMINE ATM SENSOR ORIENTATION

(B) OPTION 2 - ATM SUN SENSOR, ATM STAR TRACKER, AND IMU ORIENTATION ARE USED TO DETERMINE ATM SENSOR ORIENTATION

(C) OPTION 3 - INDEPENDENT SOURCE IS USED TO DETERMINE ATM ORIENTATION

(4) ATM MUST BE IN SOLAR INERTIAL ATTITUDE FOR OPTIONS 1 AND 2.

(5) ASTRONAUT MUST RECORD STAR TRACKER GIMBAL ANGLES AT TIME OF MARK IN OPTION 2. THESE ARE USED AS INPUT (IN14) LATER IN PROGRAM.

(6) IMU MUST BE ON AND ALIGNED FOR OPTIONS 1 AND 2.

(7) STAR TRACKER MUST BE LOCKED ON TO CELESTIAL BODY FOR OPTION 2.

(8) THE ASTRONAUT IDENTIFIES THE CELESTIAL BODY ACQUIRED BY THE STAR TRACKER. SUN AND EARTH ARE NOT VALID CELESTIAL BODIES FOR THE STAR TRACKER.

(9) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED INTO N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(10) THE ASTRONAUT HAS THE OPTION TO UPDATE OR NOT UPDATE THE CURRENTLY STORED ATM SENSOR ORIENTATION. OPTION 3 MAY BE USED TO DISPLAY CURRENT ATM SENSOR ORIENTATION.

(11) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG

CMC

GROUND

CREW

CONT

•CREW
•PROG
•SELECTION
.
.
....
.

#10

KEY IN ATM ORIENTA-
TION DETERMINATION
PROGRAM (P50).
V37E50E

#20

MONITOR DSKY:
OBSERVE DISPLAY
OF PROGRAM 50

#30

MONITOR DSKY:
OBSERVE VERB-NOJN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED ORIENTATION
DETERMINATION
TECHNIQUE.

#40

DC R00 TO START ATM
ORIENTATION DETERMI-
NATION PROGRAM (P50).
DISPLAY PROGRAM 50.

SET CMC ASSUMED
OPTION CODE IN R2
(BELOW) TO 00001

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OPTION CODE
FOR ASSUMED ORIENTA-
TION DETERMINATION
TECHNIQUE:
V04 N06
R1 - 00012
R2 - 0000X
R3 - BLANK

R1 - IS THE OPTION
CODE FOR ASSUMED
ORIENTATION DETERMI-
NATION TECHNIQUE

R2 - IS THE ASSUMED

HOLD .
.....
SNAP .

ORIENTATION DETERMI-
NATION TECHNIQUE
CODE:
00001-ATM SUN
SENSOR
00002-ATM SUN
SENSOR AND
ATM STAR
TRACKER
00003-ATM ANGLES
FROM INDE-
PENDENT
SOURCE

#50

IS THIS THE ORIENT-
ATION DETERMINATION
TECHNIQUE THAT I
DESIRE?

#60

.Y .N

WAIT FOR KEYBOARD
ENTRY.

KEY IN PROCEED

#70

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V22E AND
LOAD THE DESI-
RED CODE IN R2

P. NEW
R. CODE
O. CODE
C. CODE
E. CODE
D. CODE

#80

STORE NEW
CODE

IS ATM SUN SENSOR
OPTION (00001)
STORED?

#90

.Y .N

SET P50.1FLG

```

IS ATM SUN SENSOR
AND ATM STAR
TRACKER OPTION
(00002) STORED?
.Y .N
.(00002) .(00003)
. .
. .
. .
USE OLD ATM Y
AND Z AXES AS
NEW Y AND Z
AXES

```

WAS CODE 00003
SELECTED?

(00002) STORED?	-----	
.Y	.N	
.(00002)	.(00003)	
.	.	
.	.	

2.
Y.

GO TO
"A"
BELOW

- USE OLD ATM Y
- AND Z AXES AS
- NEW Y AND Z
- AXES

#120

MOJ38
"A"
GO TO

DO IMU STATUS CHECK
ROUTINE (R02).DO IMU STATUS CHECK
ROUTINE (R02).

#130

++ 10 ++
++ 489 ++

SFT CELESTIAL BODY
CODE = 46 (UCTAL)

0415

NO SIGHTING MARK
ROUTINE (253).

DO SIGHTING MARK
ROUTINE (R53).

#150

#160

#170

#180

#190

P50 / SKYLARK

0420

304

[illegible]

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW
DATA.

.P .NEW
.R .DATA
.O .
.C .
.E .
.E STORE NEW
.D DATA

TRANSFORM VECTOR
FROM BASIC REFERENCE
COORDINATES TO NAV
BASE COORDINATES AND
STORE AS TRACKER LOS

TRANSFER SUN VECTOR
FROM BASIC REFERENCE
COORDINATES TO NAV
BASE COORDINATES AND
STORE AS NEW Z AXIS
OF ATM

IS STORED ORIENTA-
TION DETERMINATION
TECHNIQUE CODE
00001?
(P50.IFLG SET?)

.Y N.
(00002).

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

#250

#260

#270

#280

#290

#300

#310

#320

#330

0340

306 P50/SKYLARK

V06 N23
 R1 - ALPHA ATM
 R2 - BETA ATM
 R3 - GAMMA ATM
 R1 - ALPHA ATM
 R2 - BETA ATM
 R3 - GAMMA ATM
 ARE THE DOCKING
 ANGLES WHICH SPECIFY
 THE ATM AXES ORIENT-
 TATION WITH RESPECT
 TO THE NAV BASE.
 EACH IN DEGREES TO
 THE NEAREST .01 DEG.
 (SEE SECTION 5.6 OF
 R693).

WAIT FOR KEYBOARD
 ENTRY

OF DOCKING ANGLES

AM I SATISFIED
 WITH DOCKING
 ANGLES?

.Y .N

KEY IN V25E
 AND LOAD NEW
 ANGLES

DO I WISH TO
 UPDATE ATM AXES?

.Y .N

#350

#360

#370

#380

#390

```

TERMINATE FLASH UPON ..... KEY IN PROCEED .....
RECEIPT OF PROCEED, .....
NEW DATA, OR TERMINATE (V34E) .....

```

0040

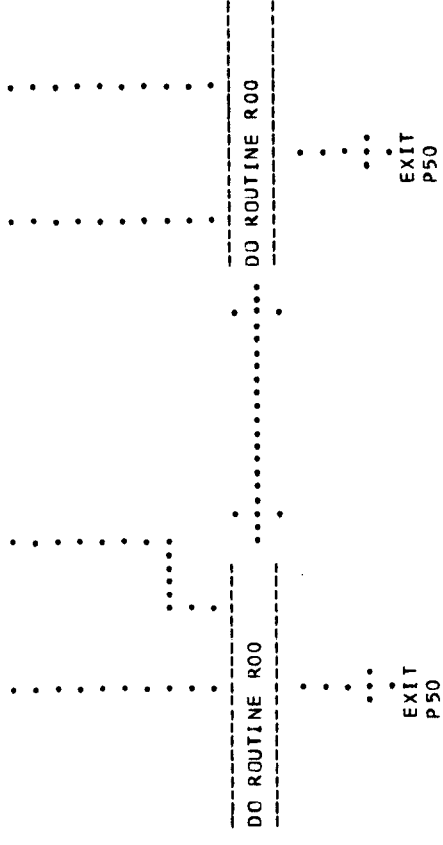
KEY IN V34E
(TERMINATE)

○【ナホ

#420

0340

0440



CHANGE CONTROL NOTES

REV 00 PCR 413,434
REV 01 PCN 489

IMU ORIENTATION DETERMINATION PROGRAM (P51) REV 01 03/20/72

PURPOSE:

(1) TO DETERMINE THE INERTIAL ORIENTATION OF THE IMU USING SIGHTINGS ON TWO CELESTIAL BODIES USING THE SCANNING TELESCOPE, THE SEXTANT, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

ASSUMPTIONS:

(1) THE IMU MAY BE:

(A) CFF (STANDBY)

(B) ON, AND ALIGNED OR NOT ALIGNED SINCE TURN ON.

IF (A) IS TRUE, THE IMU MUST BE TURNED ON BEFORE THIS PROGRAM CAN BE PERFORMED.

IF (B) IS TRUE THIS PROGRAM CAN BE COMPLETED.

(2) THERE ARE NO RESTRAINTS UPON THE CSM ATTITUDE CONTROL MODES IN THIS PROGRAM.

(3) TIME AND RCS FUEL MAY BE SAVED, AND SUBSEQUENT IMU ALIGNMENT DECISIONS GREATLY SIMPLIFIED IF THIS PROGRAM IS PERFORMED IN SUCH A WAY AS TO LEAVE THE IMU INERTIALLY STABILIZED AT AN ORIENTATION AS CLOSE AS POSSIBLE TO THE OPTIMUM ORIENTATION REQUIRED BY FUTURE CMC PROGRAMS.

(4) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(5) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(6) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED INTO N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(7) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY USKY ENTRY.

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PROG
CONT

CMC

GROUND

CREW

.CREW PROG
.SELECTION
.
...

DO NOT TO START IMU
ORIENTATION DETERM-
NATION PROGRAM (P51)
DISPLAY PROGRAM 51

KEY IN IMU
ORIENTATION DETERM-
NATION PROGRAM (P51)
V37E 51E

.
.
.
.
.
.
.

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 51

#20

IS THE ISS ON?

.Y .N

TURN ON PROGRAM
ALARM LIGHT AND
STORE ALARM
CODE 00210.

MONITOR DSKY:
DOES PROGRAM ALARM
LIGHT COME ON AND
DOES V37 FLASH INDI-
CATING THAT THE IMU
IS NOT ON?

.Y .N

TURN ON THE IMU
AND RESELECT P51
VIA R00.

#40

DO ROUTINE R00

DO ROUTINE R00

EXIT

EXIT

WC#

WC#

#60

0704

SNAP

SNAP •

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM CELESTIAL BODY
ACQUISITION:

V50 N25

R1-00015

R2 - BLANK

R3 - BLANK

MONITOR DSKY:

OBSEIVE VERB--NOUN
FLASH TO REQUEST
PLEASE PERFORM
CELESTIAL BODY
ACQUISITION

08

06番

#100

#110

#120

#130

#140

#150

WITH THE ROTA-
TION CONTROL
ORIENT THE CSM
UNTIL 2 CELES-
TIAL BODIES
ARE VISIBLE IN
THE SCT

MONITOR FCAI BALL
IS GIMBAL LOCK
IMPENDING?

SHALL I
COARSE
ALIGN IMU
TO 0.0,0
GIMBAL
ANGLES?

KEY IN ENTER

KEY IN PROCEED

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR ENTER

P
R
E
N

315

357
P51/SKYLARK

#160

POSS
TEMP
HOLD
SNAP

DISPLAY ON DSKY:

V41 N22
R1-00000
R2-00000
R3-00000

WHERE R1, R2,
AND R3 REPRESENT

CDU/ISS ANGLES
TO BE COARSE
ALIGNED TO (OG,
IG, MG, RESPEC-
TIVELY).

RESET REFSMAT
FLAG

COMMAND ISS TO
COARSE ALIGN
MODE

TURN ON "NO ATT"
LIGHT

COARSE ALIGN ISS

TERMINATE COARSE
ALIGN MODE IN

MONITOR DSKY:
OBSERVE DISPLAY
OF COARSE ALIGN
VERB AND ICDU
ANGLES (ALL
00000) FOR COARSE
ALIGNMENT

OBSERVE "NO ATT"
LIGHT ON

#170

#180

#190

#200

#210

P51/SKYLARK

ISS. RESUME ATT-
ITUDE HOLD IF
VEHICLE

TURN OFF "NO
ATT" LIGHT

GO TO
"C"
ABOVE

DO SIGHTING MARK
ROUTINE (R53) FOR
CELESTIAL BODY #1

IS CELESTIAL
BODY CODE 00?

IS THE CELESTIAL
BODY CODE 46 OR

WAIT FOR "NO ATT"
LIGHT OFF

GO TO
"C"
ABCDE

DO SIGHTING MARK
ROUTINE (R53) FOR
CELESTIAL BODY #1.
SXT IS PREFERABLE TO
SCT FOR CSM OPTICS
MARKS.

IS THE TARGET A STAR
OR THE EARTH OR SUN?

316

+ + 10 + + 489 + +

477

Y.

ORIGIN STAR
VECTOR FROM
STORED
EPHEMERIS

CALCULATE CEL-
ESTIAL BODY
VECTOR FOR THE
BODY DEFINED
BY THE STAR
CODE.

PCSS

HOLD

S NAP

FLASH VERB-
NUJN TO RE-
QUEST RESPONSE
AND DISPLAY
PLANET POSI-
TION VECTOR;

V06N88
R1-X PL
R2-Y PL
R3-Z PL

X PL - THE X
COMPONENT OF
UNIT POSITION
VECTOR OF THE
PLANET AT GET.
IN REFERENCE
COORDINATES.
TJ THE FIFTH
PLACE

MONITOR DSKY:

OBSERVE VERB-NUJN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF PLANET POSITION
VECTOR.

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

Y

N

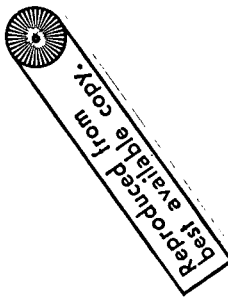
#270

#280

#290

#300

#310



(.XXXXX).

Y PL - SAME AS
X PL FOR Y
CJMPJVENT.

Z PL - SAME AS
X PL FOR Z
CJMPJVENT.

.
.
.

WAIT FOR KEY-
BOARD ENTRY

KEY IN
PROCEED

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR NEW
DATA.

.P NEW
.R DATA
.O .
.C .
.E -----
.E STORE NEW
.D DATA

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

CALCULATE CELESTIAL
BODY #1 VECTOR
W.R.T. IMU

#320

#330

#340

#350

#360

DO SIGHTING MARK ROUTINE (R53) FOR CELESTIAL BODY #2	DO SIGHTING MARK ROUTINE (R53) FOR CELESTIAL BODY #2. IF POSSIBLE USE SXT, OTHERWISE SCT.
IS CELESTIAL BODY CODE 00?	IS THE TARGET A STAR OR THE EARTH OR SUN?
.N .Y	.N .Y
IS THE CELESTIAL BODY CODE 46 OR 47?	
.N Y.	
OBTAIN STAR VECTOR FROM STORED EPHEMERIS	
CALCULATE CEL- ESTIAL BODY VECTOR FOR THE BODY DEFINED BY THE STAR CODE.	

#370

#380

#390

#400

#410

#420

#430

#440

#450

PCSS
HOLD
SNAP

FLASH VERB-
NOUN TO RE-
QUEST RESPONSE
AND DISPLAY
PLANET POSI-
TION VECTOR;
V06N88
R1-X PL
R2-Y PL
R3-Z PL

X PL - THE X
COMPONENT OF
UNIT POSITION
VECTOR OF THE
PLANET AT GET.
IN REFERENCE
COORDINATES.
TO THE FIFTH
PLACE
(.XXXXX).

Y PL - SAME AS
X PL FOR Y
COMPONENT.

Z PL - SAME AS
X PL FOR Z
COMPONENT.

WAIT FOR KEY-
BOARD ENTRY

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR NEW

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF PLANET POSITION
VECTOR.

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y
.N

KEY IN
PROCEED

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR

DATA.

P	NEW	
R	DATA	
D	.	
C	.	
E		
E		
D		

STORE NEW
DATA

CALCULATE CELESTIAL
BODY #2 VECTOR
W-R.T. IMU

DC SIGHTING DATA
DISPLAY ROUTINE
(R54)

E X I T "A" "B"

 GO IN "C"
 ABOVE

GO TO
"C"
ABOVE

CALCULATE IMU INERTIAL
ORIENTATION W.R.T.

COMPONENTS

DD SIGHTING DATA
DISPLAY ROUTINE
(R54)

E
X
I
T
"A"
.
.
.
.
.
GO TO
"C"
ABOVE

GO TO
10 C"
ABOVE

.....
CALCULATE IMU INERTIAL
ORIENTATION W.R.T.

CELESTIAL COORDIN-
ATES AS DEFINED BY
CELESTIAL BODIES #1
AND #2. STORE AS
PRESENT PLATFORM
ORIENTATION (REFS-
MMAT)

#510

SET REFSMMAT FLAG

#520

DO ROUTINE R00

DO ROUTINE R00

EXIT P51

EXIT P51

#530

CHANGE CONTROL NOTES

REV 00 PCN 410, PCR 018,043,414
REV 01 PCN 489

IMU REALIGN PROGRAM (P52)

REV 01 03/20/72

PURPOSE:

(1) TO ALIGN THE IMU FROM A "KNOWN" (SEE ASSUMPTION 4) ORIENTATION TO ONE OF THREE ORIENTATIONS SELECTED BY THE ASTRONAUT USING SIGHTINGS ON TWO CELESTIAL BODIES WITH THE SCANNING TELESCOPE, THE SIXTANT, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

(A) PREFERRED ORIENTATION

AN OPTIMUM ORIENTATION FOR A PREVIOUSLY CALCULATED MANEUVER. THIS ORIENTATION MUST BE JPLINKED OR CALCULATED AND STORED BY A PREVIOUSLY SELECTED PROGRAM.

(B) NOMINAL ORIENTATION

$$X = \text{UNIT}(Y \ X \ Z)$$

$$\text{--SM} \quad \text{--SM} \quad \text{--SM}$$

$$Y = \text{UNIT}(V \ X \ R)$$

$$\text{--SM} \quad \text{--SM} \quad \text{--SM}$$

$$Z = \text{UNIT}(-R)$$

$$\text{--SM} \quad \text{--SM}$$

WHERE:

R = THE GEOMETRIC RADIUS VECTOR AT TIME T (ALIGN)
 -- SELECTED BY THE ASTRONAUT

V = THE INERTIAL VELOCITY VECTOR AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT.

(C) REFSMMAT

SEE ASSUMPTION (4)

(2) TO ALIGN THE IMU TO A PRE-DETERMINED ORIENTATION SUITABLE FOR A PLANE-CHANGE MANEUVER AND TO REALIGN THE IMU AFTER THE MANEUVER TO THE PRE-PLANE CHANGE ORIENTATION.

$$X = \text{UNIT}(X \ \cos 45 + Y \ \sin 45) \text{ BEFORE THE MANEUVER (AFTER MANEUVER IF } \cos(\text{CDUY}) \cdot \text{VGY} < 0)$$

$$\text{--SM} \quad \text{--SMO} \quad \text{--SMO} \quad \text{LV}$$

$$X = \text{UNIT}(X \ \cos 45 - Y \ \sin 45) \text{ AFTER THE MANEUVER (BEFORE MANEUVER IF } \cos(\text{CDUY}) \cdot \text{VGY} < 0)$$

$$\text{--SM} \quad \text{--SMO} \quad \text{--SMO} \quad \text{LV}$$

$$Y = \text{UNIT}(Z \ X \ X)$$

$$\text{--SM} \quad \text{--SM} \quad \text{--SM}$$

$$Z = Z$$

$$\text{--SM} \quad \text{--SMO}$$

WHERE: SUBSCRIPT '0' REFERS TO THE ORIENTATION EXISTING BEFORE THE ALIGNMENT.

ASSUMPTIONS: (1) THE CONFIGURATION MAY BE SIVB/CSM, SKYLAB/CSM, OR CSM. THE PRESENT CONFIGURATION SHOULD HAVE BEEN ENTERED INTO

P52/SKYLARK

THE CMC BY COMPLETION OF EITHER ROUTINE R03 OR R04 AND EITHER V45 OR V46 (DEPENDENT ON CONFIGURATION).

(2) IF THE S/C CONTROL SWITCH IS IN CMC AND THE MODE SWITCH IS IN ATTITUDE HOLD OR AJTD DJRING THE GYRO TORQUING COARSE ALIGN ROUTINE (R55) OR THE GYRO TORQUING OPTION (ENTER ON V50N25, R1-13 OR PRO ON V50N25, R1-20) OR THE GYRO TRIM PORTION OF COARSE ALIGN ROUTINE (R50), THE DAP WILL MANEUVER THE VEHICLE TO FOLLOW THE PLATFORM.

(3) THIS PROGRAM MAKES NO PROVISION FOR AN ATTITUDE MANUEVER TO RETURN THE VEHICLE TO A SPECIFIC ATTITUDE. SUCH A MANUEVER IF DESIRED MUST BE DONE MANUALLY. AN OPTION IS PROVIDED HOWEVER TO POINT THE SXT AT ASTRONAUT OR CMC SELECTED STARS EITHER MANUALLY BY CREW INPUT OR AUTOMATICALLY UNDER CMC CONTROL.

(4) THE ISS IS ON AND HAS BEEN ALIGNED TO A KNOWN ORIENTATION WHICH IS STORED IN THE CMC (REFS44AT). THE PRESENT IMU ORIENTATION DIFFERS FROM THAT TO WHICH IT WAS LAST ALIGNED ONLY DUE TO GYRO DRIFT (I.E., NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION HAS OCCURRED SINCE THE LAST ALIGNMENT).

(5) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(6) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(7) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(6) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY FOR PURPOSE 1 AND BY MINKEY CONTROLLER (R07) FOR PURPOSE 2.

PROG CONT	CMC	GROUND	CREW
	.AUTOMATIC		.CREW PROG
	.PROGRAM		.SELECTION
	.SELECTION		.
	.		.

	.		.
	-----		-----
	DO ROO TO START INU .		KEY IN IMU REALIGN
	REALIGN PROGRAM (P52).....		PROGRAM (P52)
	DISPLAY PROGRAM 52 .		V37E 52E

			.
			.
			.
			.
			.

			MONITOR DSKY:
			OBSERVE DISPLAY OF
			PROGRAM 52

			.
			.
			.
			.
			.
			.

			.

DO IMU STATUS CHECK
ROUTINE (R02)

#30

IS AUTOSEQ FLAG SET?

IS UTFLAG SET
AND IS P20
OPTION=2?

#40

SET TRACK
FLAG

#50

COMPUTE PLANE
CHANGE ORIENTA-
TION FOR GIMBAL
ANGLE COMPUTATION
(NOTE: AT THIS
TIME ANY PREFERRED
ORIENTATION
STORED IN THE
CMC IS LOST).

#60

SET PREFERRED
ORIENTATION FLAG

#70

080

067

#001

4110

#120

326

VU+ A26
R1-00001
R2-0000X
R3-BLANK

RI IS THE OPTION
CODE FOR ASSUMED
IMU ORIENTATION
SELECTION

R2 IS THE CMC
ASSUMED OPTION:
00001-PREFERRED
00002-AJMINAL
00003-REFSMAT

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

```

P .
R .
D .
C .
F .
E .
D .

NEW
CODE
.
.
-----
STORE CODE
-----

```

IS STORED ORIENTA-
TION CODE 00001?

ORIENTATION SELECTION

IS THIS THE IMU ORIENTATION I DESIRE?

 γ

KEY IN PROCEED

KEY IN V22E
AND LOAD THE
DESIRED ORIEN-
TATION CODE IN
R2

WAS PREFERRED ORIENTATION SELECTED?

Y

Z

#180

#190

#200

#210

#220

328

P52/SKYLARK

R1- T(ALIGN)-HRS
R2- T(ALIGN)-MINS
R3- T(ALIGN)-SECS

T(ALIGN- TIME (GET)
AT WHICH VEHICLE
POSITION AND VELO-
CITY VECTORS ARE SE-
LECTED TO DEFINE IMU
AND CSM NOMINAL ORI-
ENTATION. IN HRS,
MINS AND SECS TO
NFAREST .01 SEC.

OF T(ALIGN).

T(ALIGN) WILL APPEAR
HERE AS 00000,
00000, 00000, WHICH
IF ACCEPTED WILL
INDICATE THAT THE
NOMINAL ORIENTATION
WILL BE DEFINED FOR
A T(ALIGN) AUTOMATI-
CALLY SELECTED AS
THE PRESENT TIME

DO I WISH TO ALIGN
THE IMU TO AN ORIEN-
TATION DEFINED BY
THE T(ALIGN) PRE-
SENTLY DISPLAYED?

.Y .N

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P .NEW
.R .DATA
.D .
.C .
.E .STORE
.E .NEW
.D .

#230

#240

#250

#260

#270

#280

#290

#300

#310

#320

DATA

IS T(ALIGN) DEFINED
TO BE= 0?

.Y .N

DEFINE T(ALIGN)
= T PRESENT.

FIND CSM
STATE AT T(A-
LIGN) USING
PRECISION
INTEGRATION
MODE

.

COMPUTE NOMINAL
ORIENTATION FOR
THE PREVIOUSLY
DEFINED
T(ALIGN). SEL-
ECT THIS ORIE-
NTATION FOR
GIMBAL ANGLES
COMPUTATION.
(NOTE: AT THIS

331

375
P52/SKYLARK

TIME ANY PRE-
FERRED ORIENTA-
TION STORED IN
THE CMC IS
LOST).

#330

"A"
FROM
ABOVE

#340

READ VEHICLE ATTITUDE FROM GIMBAL ANGLES

#350

COMPUTE GIMBAL ANGLES AT SELECTED IMU ORIENTATION AND PRESENT VEHICLE ATTITUDE

#360

"A"
FROM
ABOVE

#370

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY THE RESULTING GIMBAL ANGLES: V06 N22

MONITOR DSKY: OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF GIMBAL ANGLES

P52/SKYLARK

R1-OG ROLL
R2-IG PITCH
R3-MG YAW

ALL GIMBAL ANGLES IN
DEGREES TO NEAREST
.01 DEGREE

AFTER PROPOSED CSM/
IMU ALIGNMENT

IS MIDDLE GIMBAL
ANGLE SATISFACTORY?

.Y .N

BY SUITABLE MODE
SELECTION ENSURE
THAT VEHICLE IS
AS INERTIALLY
STABLE AS
POSSIBLE TO EN-
SURE ACCURACY OF
IMJ COARSE
ALIGNMENT.

WAIT FOR KEYBOARD
ENTRY

DO I WISH TO
MANEUVER VEHICLE
TO AN ATTITUDE
WHICH WILL PRO-
VIDE A MORE
SUITABLE MGA?

.N .Y

MANEUVER VEH-
ICLE WITH

#380

#390

#400

#410

#420

ROTATION
CONTROLLER

05430

UPDATE THE
DISPLAY OF
RESULTING
GIMBAL ANGLES
KEY IN RECY-
CLE V32E

○々々々

SELECT NEW
PROGRAM
KEY IN V37EXXE

EXIR P52

#460

KEY IN PROCEED

0270

TERMINATE FLASH UPON
RECEIPT OF PROCEED
RECYCLE OR NEW PRO-
GRAM

```

R
E
P
R
NEW
PROG

```

334

#530

#540

#550

#560

#570

GO TO
"D"
BELOW

KEY IN ENTER
NOTE: AFTER
PC MANEUVER
ENTER RES-
PONSE WILL
RESULT IN
402 ALARM
AND CONTINUE
FL V50 N25

IS THIS 1ST PLANE
CHANGE ALIGNMENT?
(IS THE PCFLAG SET?)

N Y

DO ROUTINE R00

DO ROUTINE R00

EXIT P52

EXIT P52

LIGHT PLO-
GRAM ALARM
AND STORE
ALARM CODE
402

++
+01
POSS
HOLD
.....
SNAP
+
+489
++

#580

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM NORMAL OR GYRO
TORQUE COARSE ALIGN:
V50N25
R1-0J013
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM
NORMAL OR GYRO TOR-
QUE COARSE ALIGN

#590

THE NORMAL METHOD
OF ACHIEVING IMU
REALIGNMENT IS TO
ACCEPT THIS REQUEST
BY KEYING IN PROCEED
WHICH WILL CAUSE THE
CMC TO COARSE ALIGN
AND GYRO TRIM THE
STABLE MEMBER TO THE
GIMBAL ANGLES COM-
PUTED FOR THE
NEW ORIENTATION AND
THEN TO PROCEED
THROUGH OPTICAL
SIGHTINGS AND PULSE
TORQUING TO ACHIEVE
FINAL ALIGNMENT.
AN ALTERNATE METHOD
OF ACHIEVING IMU
REALIGNMENT IS TO
KEY IN ENTER WHICH
WILL CAUSE THE CMC
TO COMPUTE THE NUM-
BER OF TORQUING
PULSES REQUIRED BY
EACH IRIG (X,Y,Z)
IN ORDER TO ACHIEVE

#600

#610

#620

PRECISE ALIGNMENT,
AND ISSUE THESE
PULSES. THIS ALTER-
NATE METHOD INTRO-
DUCE A PREDICTABLE
ERROR INTO THE CMC'S
KNOWLEDGE OF THE
STABLE MEMBER ORIEN-
TATION AND TAKES A
PREDICTABLE PERIOD
OF TIME FOR COMPLET-
ION.

AN APPROXIMATION OF
THIS ERROR AND THE
TIME TO TORQUE CAN
BE MADE BY CALCULA-
TING THE SUM OF THE
GIMBAL ANGLE CHAN-
GES, MULTIPLYING BY
2 FOR TIME TO TORQUE
IN SECONDS, AND MUL-
TIPLYING BY .002 FOR
ERROR IN DEGREES.
SHALL I REALIGN IN
THE NORMAL WAY?

WAIT FOR KEYBOARD
ENTRY

Y N

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR ENTER

ENTER

P
R
D
C
E
E
D

"D"

COMPUTE TORQUING
ANGLES REQUIRED

#630

#640

#650

#660

#670

TO ACHIEVE NEW
ORIENTATION.

RESET REFSMMAT
FLAG

PULSE IRIG'S
THROUGH TORQUING
ANGLES AND DIS-
PLAY PRESENT ICDU
ANGLES UNTIL
COMPLETION.

V16N20
R1-DG ROLL
R2-IG PITCH
R3-MG YAW

ALL GIMBAL ANGLES
IN DEGREES TO
NEAREST .01
DEGREES.

STORE THE DESIRED
IMU ORIENTATION
IN REFSMMAT AND
SET REFSMMAT FLAG

GO TO
"C"
BELOW

TEMP
HOLD
MON

#680

#690

#700

#710

"D"

MONITOR DSKY:
OBSERVE VERB-NOUN
DISPLAY OF PRE-
SENT GIMBAL
ANGLES UNTIL COM-
PLETION OF PULSE
TORQUING
NOTE 1: IT IS NOT
NECESSARY TO
MAINTAIN A FIXED
INERTIAL ORIENTA-
TION OF SPACE-
CRAFT DURING
PULSE TORQUING.
NOTE 2: IF IT
APPEARS THAT THE
IMU WILL BE PULSE
TORQUED INTO THE
GIMBAL LOCK THE
ASTRONAUT SHOULD
MANEUVER THE
VEHICLE TO AVOID
THAT CONDITION.

GO TO
"C"
BELOW

339

383
P52/SKYLARK

#720

SELECT FINAL DESIRED
IMU ORIENTATION FROM
STORAGE FOR USE BY
THE COARSE ALIGN
ROUTINE (R50)

#730

DC COARSE ALIGN
ROUTINE (R50)

DO COARSE ALIGN
ROUTINE (R50)

#740

#750

STORE THE
PRESENT
IMU OR-
IENTAT-
TION IN
REFSMAT
AND SET
REFSMAT
FLAG

#760

P52/SKYLARK

1983

•

POSS

VEH

二、

70-2
71-01

155

End

R

31

MAY BE ACQUIRED.
MONITOR FDAI BALL
TO AVOID GIMBAL
LOCK. (NOTE: ASTRO-
NAUT MAY USE OPTICS
TO ASSIST ATTITUDE
CHOICE OR MAY MANEJ-
VER AT RANDOM.)

#820

TERMINATE FLASH UPON
RECEIPT OF ENTER OR
PROCEED

ENTER PROCEED

DO STAR SELECTION
ROUTINE (REFER TO
SECTION 5.6 OF R693)

TWO
STARS
AVAILABLE NOT
AVAILABLE

FLASH VERB-NOUN
TO REQUEST RES-
PONSE AND DIS-
PLAY ALARM CODE:

V05N09

R1-

R2-

R3-

EXPECTED ALARM
CODE AT THIS
TIME IS 405

PCSS
HOLD
SNAP

KEY IN PROCEED

MONITOR DSKY:
DOES ALARM
CODE DISPLAY
INDICATE THAT TWO
STARS ARE NOT AVAIL-
ABLE IN THE SXT
FIELD OF VIEW?

Y N

SHALL I BYPASS
STAR SELECTION

#860

ROUTINE AND
SELECT MY OWN
CELESTIAL
BODY?

.Y .N

#870

MANEUVER
VEHICLE UN-
TIL A SUIT-
ABLE CELES-
TIAL BODY
IS ACQUIRED

#880

KEY IN PRO-
CEED

#890

WAIT FOR KEY-
BOARD ENTRY

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR RE-
CYCLE.

KEY IN RE-
CYCLE
V32E

#900

.P
.R
.D
.C
.Y
.E
.L
.D

#910

++
+01
++
DE=CELESTIAL BODY
CODE
NOTE: N70 DISPLAYS
RESULTS OF
SUCCESSFUL
STAR SELECTION
ROUTINE OTHER-
WISE CONTAINS
RESIDUAL DATA
+489
++

#960

#970

IS CODE SATIS-
FACTORY?

.Y .N

KEY IN V21E
AND CHANGE
CODE

#980

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P
.NEW
.DATA
.R
.D
.C
.E
STORE NEW DATA
.E
.D

#990

#1000

IS THE CE-
LESTIAL
BODY CODE
NEGATIVE?

IS BODY CODE = 00?

.Y
.N

#1010

TURN ON OPERATOR
ERROR LIGHT

#1020

IS THE CELESTIAL
BODY CODE >47
(OCTAL)?

.Y
.N

#1030

IS C=1 (ATM
SUN SENSOR)?

.Y
.N

#1040

IS DE=46 (SUN)?

N
.Y

#1050

TURN ON
OPERATOR ERROR

#1060

#1070

#1080

#1090

#1100

P52/SKYLARK

346

LIGHT

IS CELESTIAL BODY
CODE 00?

.N .Y

IS THE CELESTIAL
BODY CODE 46 OR
47?

.N .Y

OBTAIN STAR
VECTOR FROM
STORED
EPHEMERIS

CALCULATE CEL-
ESTIAL BODY
VECTOR FOR THE
BODY DEFINED
BY THE CELEST-
IAL BODY CODE

POSS
HOLD
SNAP

FLASH VERB-NOUN
TO REQUEST RE-
SPONSE AND DIS-
PLAY PLANET

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

POSITION
VECTOR:
V05N88
R1-X PL
R2-Y PL
R3-Z PL

X PL - THE X
COMPONENT OF
UNIT POSITION
VECTOR OF THE
PLANET AT GET.
IN REFERENCE
COORDINATES.
TO THE FIFTH
PLACE
(.XXXXX).

Y PL - SAME AS
X PL FOR Y
COMPONENT.

Z PL - SAME AS
X PL FOR Z
COMPONENT.

WAIT FOR KEY-
BOARD ENTRY

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR NEW
DATA.

P NEW
R DATA
O
C
E
STORE NEW
D DATA

OF PLANET POSITION
VECTOR.

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y .N

KEY IN
PROCEED

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

#1110

#1120

#1130

#1140

#1150

#1160

#1170

#1180

#1190

#1200

IS C=0 (CSM OPTICS)?	IS CSM OPTICS SELECTED?
.Y	.Y
.N	.N
DO SIGHTING MARK ROUTINE (R53)	DO SIGHTING MARK ROUTINE (R53)
DO AUTO OPTICS POSITIONING ROUTINE R52 (INCLUDES SIGHT- ING MARK ROUTINE (R53))	DO AUTO OPTICS POSITIONING ROUTINE R52 (INCLUDES SIGHTING MARK ROUTINE (R53))
IS CELESTIAL BODY CODE 00?	IS THE TARGET A STAR OR THE EARTH OR SUN?
.N	.N
.Y	.Y
IS THE CELESTIAL BODY CODE 46 OR 47?	
.N	
.Y	

#1210

#1220

#1230

#1240

#1250

OBTAIN STAR
VECTOR FROM
STORED
EPHEMERIS

CALCULATE CEL-
ESTIAL BODY
VECTOR FOR THE
BODY DEFINED
BY THE STAR
CODE.

FLASH VERB-
NOUN TO RE-
QUEST RESPONSE
AND DISPLAY
PLANET POSI-
TION VECTOR;
V06N88
R1-X PL
R2-Y PL
R3-Z PL

X PL - THE X
COMPONENT OF
UNIT POSITION
VECTOR OF THE
PLANET AT GET.
IN REFERENCE
COORDINATES.
TO THE FIFTH
PLACE
(.XXXXX).

POSS
HOLD
.....
SNAP

.....
MONITOR DSKY:

OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF PLANET POSITION
VECTOR.

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y .N

#1260

#1270

#1280

#1290

#1300

Y PL - SAME AS
X PL FOR Y
COMPONENT.

Z PL - SAME AS
X PL FOR Z
COMPONENT.

WAIT FOR KEY-
BOARD ENTRY

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR NEW
DATA.

.P .NEW
.R .DATA
.O .
.C .
.E .
.E STORE NEW
.D DATA

HAVE TWO CELEST-
IAL BODIES BEEN
MARKED?

.N .Y

KEY IN
PROCEED

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

HAVE I MARKED TWO
CELESTIAL BODIES?

.Y .N

A 10x10 grid of dots. A 3x3 square of dots in the top-left corner is highlighted by a dashed line.

IS THIS A MINKEY
PLANE-CHANGE
ALIGNMENT?
(AUTOSEQ FLAG
SET?)

Y.
Z.

RESET PCFLAG

DO ROUTINE
R00

EXIT P52

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM FINE ALIGN:

V50 N25
R1-00014
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE VERB--
FLASH TO REQUIRE
PLEASE PERFORM
ALIGN.

DO I WANT TO REDO
THE CELESTIAL BODY

IS THIS A MINKEY PLANE-CHANGE ALIGNMENT?

•
•

DO ROUTINE
R00 .

EXIT P52

489

#1360

#1370

#1380

#1390

#1400

SIGHTINGS, SIGHT-
ING DATA TEST, AND
GYRO TORQUING TO
VERIFY THE ACCURACY
OF ALIGNMENT?
NOTE: IF THE SIGHT-
ING DATA WAS BAD OR
THE TORQUING ANGLES
WERE LARGE THE
ASTRONAUT SHOULD
PROCEED AND REDD THE
ALIGNMENT.

#1410

#1420

#1430

#1440

#1450

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR ENTER

.P
.R
.O
.C
.E
.E
.D
...
GO TO
"B"
ABOVE

KEY IN
ENTER

KEY IN
PRO-
CEED

.
.
.
...
GO TO
"B"
ABOVE

DO ROUTINE R00

DO ROUTINE R00

REV 01 03/20/72

BACKUP IMU ORIENTATION DETERMINATION PROGRAM (P53)

PURPOSE:

(1) TO DETERMINE THE INERTIAL ORIENTATION OF THE IMU USING A BACKUP OPTICAL DEVICE, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

ASSUMPTIONS: (1) THE IMU MAY BE:

(A) OFF (STANDBY)

(B) ON, AND ALIGNED OR NOT ALIGNED SINCE TURN ON.

IF (A) IS TRUE, THE IMU MUST BE TURNED ON BEFORE THIS PROGRAM CAN BE PERFORMED.
IF (B) IS TRUE THIS PROGRAM CAN BE COMPLETED.

(2) THIS PROGRAM AND ITS ROUTINES HAVE THE SAME DISPLAY SEQUENCE AS P31 EXCEPT THAT R56 IS CALLED IN PLACE OF R53.

(3) THE CSM ATTITUDE CONTROL MODE SELECTED IS AT THE OPTION OF THE CREW.

(4) TIME AND RCS FUEL MAY BE SAVED, AND SUBSEQUENT IMU ALIGNMENT DECISIONS GREATLY SIMPLIFIED IF THIS PROGRAM IS PERFORMED IN SUCH A WAY AS TO LEAVE THE IMU INERTIALLY STABILIZED AT AN ORIENTATION AS CLOSE AS POSSIBLE TO THE OPTIMUM ORIENTATION REQUIRED BY FUTURE CMC PROGRAMS.

(5) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(6) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(7) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY OSKY ENTRY.

PROG
CONT

CREW

GROUND

CMC

.CREW PROG
.SELECTION
...

DC RUD TO START
BACKUP IMU ORIENTA-
TION DETERMINATION
PROGRAM (P53)
DISPLAY PROGRAM 53

KEY IN BACKUP IMU
ORIENTATION DETERMI-
NATION PROGRAM (P53)
V37E 53E

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 53

#20

IS ISS JN?

.Y .N

TURN ON PROGRAM
ALARM AND STORE
ALARM CODE
00210

#30

MONITOR DSKY:
DOES PROGRAM ALARM
LIGHT COME ON AND
DOES V37 FLASH INDICATING
THAT THE IMU IS NOT ON?

.Y .N

#40

TURN ON THE
IMU AND RESELECT P53 VIA
R00.

DO ROUTINE R00

DO ROUTINE R00

#50

EXIT
P53

EXIT
P53

#60

#110

WITH THE ROT-
ATIONAL HAND
CONTROLLER
ORIENT THE CSM

#120

MONITOR FCAI BALL
IS GIMBAL LOCK
IMPENDING?

.Y .N

#130

SHALL I
COARSE
ALIGN IMU
TO 0,0,0
GIMBAL
ANGLES?

.N .Y

#140

WAIT FOR KEYBOARD
ENTRY

KEY IN
ENTER

#150

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR ENTER

KEY IN PROCEED

.P .E
.R .N
.O .T

#160

#170

#180

#190

#200

#210

POSS
TEMP
HOLD
SNAP

C
E
R
E
D

DISPLAY ON DSKY:

V41 N22
R1-00000
R2-00000
R3-00000

WHERE R1, R2,
AND R3 REPRESENT
COU/ISS ANGLES
TO BE COARSE
ALIGNED TO (DG,
IG, MG, RESPEC-
TIVELY).

RESET REFSMMAT
FLAG

COMMAND ISS TO
COARSE ALIGN
MODE

TURN ON "NO ATT"
LIGHT

COARSE ALIGN ISS

TERMINATE COARSE
ALIGN MODE IN

MONITOR DSKY:
OBSERVE DISPLAY
OF COARSE ALIGN
VERB AND ICDO
ANGLES (ALL
00000) FOR COARSE
ALIGNMENT

OBSERVE "NO ATT"
LIGHT ON

#230

#240

\$250

#260

360

P53 / SKYLARK

++01++489++

ISS. RESUME ATTITUDE HOLD OF VEHICLE.

TURN OFF "NO
ATTN LIGHT

WAIT FOR "NO ATT"
LIGHT OFF

DO ALTERNATE LOS
SIGHTING MARK
ROUTINE (R56) FOR
CELESTIAL BODY #1

DO ALTERNATE LOS
SIGHTING MARK
ROUTINE (R56) FOR
CELESTIAL BODY #1

CALCULATE CELESTIAL
BODY #1 VECTOR W.R.T
IMU

DO ALTERNATE LOS
SIGHTING MARK ROU-
TTINE (R56) FOR
CELESTIAL BODY #2

DO ALTERNATE LOS
SIGHTING MARK ROU-
TINE (R56) FOR
CELESTIAL BODY #2

#270

08280

#290

#300

#310

BACKUP IMU REALIGN PROGRAM (P54)

REV 01 03/20/72

PURPOSE:

(1) TO ALIGN THE IMU FROM A "KNOWN" (SEE ASSUMPTION 4) ORIENTATION TO ONE OF THREE ORIENTATIONS SELECTED BY THE ASTRONAUT USING SIGHTINGS ON TWO CELESTIAL BODIES WITH A BACKUP OPTICAL DEVICE, THE ATM SUN SENSOR, OR THE ATM STAR TRACKER.

(A) PREFERRED ORIENTATION

AN OPTIMUM ORIENTATION FOR A PREVIOUSLY CALCULATED MANEUVER. THIS ORIENTATION MUST BE CALCULATED AND STORED BY A PREVIOUSLY SELECTED PROGRAM.

(B) NOMINAL ORIENTATION

$X = \text{UNIT}(Y \ X \ Z)$
-SM -SM -SM

$Y = \text{UNIT}(V \ X \ R)$
-SM - -

$Z = \text{UNIT}(-R)$
-SM -

WHERE:

$R =$ THE GEOCENTRIC RADIUS VECTOR AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT

$V =$ THE INERTIAL VELOCITY VECTOR AT TIME T (ALIGN) SELECTED BY THE ASTRONAUT.

(C) REFSMAT

SEE ASSUMPTION (4)

ASSUMPTIONS:

(1) THE DOCKED CONFIGURATION MAY BE SIVB/CSM, SKYLAB/CSM, OR CSM. THE PRESENT CONFIGURATION SHOULD HAVE BEEN ENTERED INTO THE CMC BY COMPLETION OF EITHER ROUTINE R03 OR R04 AND EITHER V45 OR V46 (DEPENDENT ON CONFIGURATION).

(2) IF THE S/C CONTROL SWITCH IS IN CMC AND THE MODE SWITCH IS IN ATTITUDE HOLD OR AUTO DURING THE GYRO TORQUING ROUTINE (R55) OR THE GYRO TORQUING OPTION (ENTER ON V50N25, R1=13), OR THE GYRO TRIM PORTION OF COARSE ALIGN ROUTINE (R50), THE CAP WILL MANEUVER THE VEHICLE TO FOLLOW THE PLATFORM.

(3) THIS PROGRAM MAKES NO PROVISION FOR AN ATTITUDE MANEUVER TO RETURN THE VEHICLE TO A SPECIFIC ATTITUDE. SUCH A MANEUVER, IF DESIRED, MUST BE DONE MANUALLY.

(4) THE ISS IS ON AND HAS BEEN ALIGNED TO A KNOWN ORIENTATION WHICH IS STORED IN THE CMC (REFSMAT). THE PRESENT IMU ORIENTATION DIFFERS FROM THAT TO WHICH IT WAS LAST ALIGNED ONLY DUE TO GYRO DRIFT (I.E. NEITHER GIMBAL LOCK NOR IMU POWER INTERRUPTION HAS OCCURRED SINCE THE LAST ALIGNMENT).

(5) IF ATM SUN SENSOR IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, ATM MUST BE IN SOLAR INERTIAL ATTITUDE, AND ATM ORIENTATION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(6) IF ATM STAR TRACKER IS USED AS SOURCE OF SIGHTING DATA, CSM MUST BE DOCKED TO ORBITAL ASSEMBLY, AND ATM ORIENTA-

TION WITH RESPECT TO NAV BASE MUST BE KNOWN.

(7) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(8) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

[illegible]

IS PREFERRED ORIENTATION FLAG SET?

2.

SET OP-

SECTION CODE

IN R2 BE-

39 2N NI = MOI

LOW - 10000

SET OPTION

CODE IN R2

CODE IN KZ
BELOW = 00003

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY OPTION CODE
FOR ASSUMED IMU

SELECT IDN:

VO4 NO6

81-00001
904 NOV 8

R1-00001
R2-0000X

R2-0000X
R3-BLANK

RI IS THE OPTION
CODE FOR ASSUMED
IMU ORIENTATION

MONITOR DSKY:
OBSERVE VERB=NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF OPTION CODE FOR
ASSUMED IMU
ORIENTATION
SELECTION

#90

#100

#110

#120

#130

SELECTION

R2 IS THE CMC
ASSUMED OPTION:
00001-PREFERRED
00002-NJMINAL
00003-REFSYNAT

IS THIS THE IMU ORI-
ENTATION I DESIRE?

.Y .N

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V22E
AND LOAD THE
DESIRED ORIEN-
TATION CODE IN
R2

.P .NEW
.R .CODE
.D .
.C .
.E .
.E STORE CODE
.D .

IS STORED ORIENTA-
TION CODE 00001?

WAS PREFERRED ORIEN-
TATION SELECTED?

.N .Y

.N .Y

SELECT PRE-
ferred IMU

GO TO

ORIENTATION
FOR GIMBAL
ANGLE COMPU-
TATION

"A"
BELOW

#140

GO TO
"A"
BELOW

#150

IS STORED ORIENTA-
TION CODE 00002?

WAS NOMINAL ORIENTA-
TION SELECTED?

.Y .N
.(NOM) .(REF)
.
.
.
.
GO TO
"B"
BELOW

#160

STORE 00000, 00000,
00000 FOR DISPLAY
AS T(ALIGN)

#170

POSS
HOLD
.....
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY T (ALIGN):
V06N34
R1-T(ALIGN)-HRS
R2-T(ALIGN)-MINS
R3-T(ALIGN)-SECS

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF T (ALIGN).

#180

#190

#200

#210

#220

#230

T(ALIGN) - TIME
(GET) AT WHICH
VEHICLE POSITION AND
VELOCITY VECTORS
ARE SELECTED TO DE-
FINE IMU AND CSM
NOMINAL ORIENTATION.
IN HRS, MINS, AND
SECS TO NEAREST .01
SEC.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P .NEW
.R .DATA
.O .
.C .
.E .
.E STORE
.D NEW
DATA

T(ALIGN) WILL APPEAR
HERE AS 00000, 00000
00000, WHICH IF AC-
CEPTED WILL INDICATE
THAT THE NOMINAL
ORIENTATION WILL BE
DEFINED FOR A
T(ALIGN) AUTOMATI-
CALLY SELECTED AS
THE PRESENT TIME

DO I WISH TO ALIGN
THE IMU TO AN ORIE-
NTATION DEFINED BY
THE T(ALIGN) PRE-
SENTLY DISPLAYED?

.Y .N

KEY IN
PROCEED

KEY IN V25E AND
LOAD THE DESIRED
T(ALIGN) IN R1,
R2, AND R3.

.....

#240

#250

#260

#270

#280

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

IS T(ALIGN) DEFINED
TO BE = 0?

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

DEFINE T (ALIGN)
= T PRESENT.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

FIND CSM STATE
AT T(ALIGN)
USING PRECI-
SION INTEGRA-
TION

.....

COMPUTE NOMINAL
ORIENTATION FOR
THE PREVIOUSLY
DEFINED T(ALIGN).
SELECT THIS OR-
IENTATION FOR
GIMBAL ANGLES
COMPUTATION.
(NOTE: AT THIS
TIME ANY REFER-
RED ORIENTATION
STORED IN THE CMC
IS LOST).

.....

#290

#300

#310

#320

#330

370

"A"
FROM
ABOVE

READ VEHICLE ATTITUDE FROM GIMBAL ANGLES

COMPUTE GIMBAL ANGLES AT SELECTED IMU ORIENTATION AND PRESENT VEHICLE ATTITUDE

"A"
FROM
ABOVE

FLASH VERB-NOUN TO REQUEST RESPONSE AND DISPLAY THE RESULTING GIMBAL ANGLES:
V06 N22
R1-OG ROLL
R2-IG PITCH
R3-MG YAW

ALL GIMBAL ANGLES IN

MONITOR DSKY:
OBSERVE VERB-NOUN FLASH TO REQUEST RESPONSE AND DISPLAY OF GIMBAL ANGLES AFTER PROPOSED CSM/IMU ALIGNMENT

++
+01
POSS
HOLD
++489
++

DEGREES TO NEAREST
•01 DEGREE

IS MIDDLE GIMBAL
ANGLE SATISFACTORY?

•Y •N

BY SUITABLE MODE
SELECTION ENSURE
THAT VEHICLE IS
AS INERTIALLY
STABLE AS
POSSIBLE TO EN-
SURE ACCURACY OF
IMU COARSE
ALIGNMENT.

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

DO I WISH TO
MANEUVER VEHICLE
TO AN ATTITUDE
WHICH WILL PRO-
VIDE A MORE
SUITABLE MGA?

•N •Y

MANEUVER VEH-
ICLE WITH
ROTATION
CONTROLLER

UPDATE THE
DISPLAY OF
RESULTING
GIMBAL ANGLES
KEY IN RECY-

#340

#350

#360

#370

#380

REALIGNMENT IS TO
ACCEPT THIS REQUEST
BY KEYING IN PROCEED
WHICH WILL CAUSE THE
CMC TO COARSE ALIGN
AND GYRO TRIM THE
STABLE MEMBER TO
THE GIMBAL ANGLES
COMPUTED FOR THE
NEW ORIENTATION AND
THEN TO PROCEED
THROUGH OPTICAL
SIGHTINGS AND PULSE
TORQUING TO ACHIEVE
FINAL ALIGNMENT.
AN ALTERNATE METHOD
OF ACHIEVING IMU
REALIGNMENT IS TO
KEY IN ENTER WHICH
WILL CAUSE THE CMC
TO COMPUTE THE NUM-
BER OF TORQUING
PULSES REQUIRED BY
EACH IRIG (X,Y,Z)
IN ORDER TO ACHIEVE
PRECISE ALIGNMENT,
AND ISSUE THESE
PULSES. THIS ALTER-
NATE METHOD INTRO-
DUCES A PREDICTABLE
ERROR INTO THE CMC'S
KNOWLEDGE OF THE
STABLE MEMBER ORien-
TATION AND TAKES A
PREDICTABLE PERIOD
OF TIME FOR COMPLET-
ION.

AN APPROXIMATION OF
THIS ERROR AND THE
TIME TO TORQUE CAN
BE MADE BY CALCULA-
TING THE SUM OF THE
GIMBAL ANGLE CHAN-
GES, MULTIPLYING BY
2 FOR TIME TO TORQUE
IN SECONDS, AND MUL-
TIPLYING BY .002 FOR
ERROR IN DEGREES.

WAIT FOR KEYBOARD
ENTRY

#440

#450

#460

#470

#480

SHALL I REALIGN IN
THE NORMAL WAY?

.Y .N
.
.

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR ENTER

.P .ENTER
.R .
.O .
.C .
.E .
.E .
.D .
.

COMPUTE TORQUING
ANGLES REQUIRED
TO ACHIEVE NEW
ORIENTATION.

RESET REFSMAT
FLAG

PULSE IRIG'S
THROUGH TORQUING
ANGLES AND DIS-
PLAY PRESENT ICDO
ANGLES UNTIL

MONITOR DSKY:
OBSERVE VERB-NDUN
DISPLAY OF PRE-
SENT GIMBAL
ANGLES UNTIL COM-

#490

#500

#510

#520

375

#530

PLETION OF PULSE
TORQUING
NOTE 1: IT IS NOT
NECESSARY TO
MAINTAIN A FIXED
INERTIAL ORIENTA-
TION OF SPACE-
CRAFT DURING
PULSE TORQUING.
NOTE 2: IF IT
APPEARS THAT THE
IMU WILL BE PULSE
TORQUED INTO
GIMBAL LOCK THE
ASTRONAUT SHOULD
MANEUVER THE
VEHICLE TO AVOID
THAT CONDITION.

#550

095#

MO738
"Ju"
01 09

#570

COMPLETION.
V13-N20
R1-OG ROLL
R2-IG PITCH
R3-MG YAW

ALL 3 IMBAL ANGLES
IN DEGREES TO
NEAREST .01
DEGREES.

STORE THE DESIRED
IMU ORIENTATION
IN REFSMMAT
AND SET REFSMMAT
FLAG

MD 738
u3u
GO TO

SELECT FINAL DESIRED
IMU ORIENTATION FROM
STORAGE FOR USE BY
THE COARSE ALIGN
ROUTINE (R50)

P54/SKYLARK

#620

P54/SKYLARK

[illegible]

DO I WISH TO HAVE
THE CMC ASSIST ME IN
SELECTING TWO CEL-
ESTIAL BODIES SUIT-
ABLE FOR ALIGNMENT?

• NO • YES

WAIT FOR KEYBOARD
ENTRY

KEY IN ENTER

MANEUVER VEHICLE UN-
TIL SUITABLE CEL-
ESTIAL BODIES MAY BE
ACQUIRED. MONITOR
FDAT BALL TO AVOID
GIMBAL LOCK.
(NOTE: ASTRONAUT MAY
USE OPTICS TO ASSIST
ATTITUDE CHOICE OR
MAY MANEUVER AT
RANDOM.)

TERMINATE FLASH UPON
RECEIPT OF ENTER
OR PROCEED

• ENTER • PROCEED

DO STAR SELECTION
ROUTINE (REFER TO

#630

#640

#650

#660

#670

SECTION 5.6 OF
R693).

• TWO
• STARS
• AVAILABLE NOT
• AVAILABLE

POSS
HOLD
.....
SNAP

FLASH VERB-NOUN
TO REQUEST RES-
PONSE AND DIS-
PLAY ALARM CODE:

V05N09
R1-
R2-
R3-

EXPECTED ALARM
CODE AT THIS
TIME IS 405

.....
+
.....

#680

#690

#700

#710

#720

MONITOR DSKY:
DOES ALARM
CODE DISPLAY
INDICATE THAT TWO
STARS ARE NOT AVAIL-
ABLE IN THE SXT
FIELD OF VIEW?

• Y • N

SHALL I BYPASS
STAR SELECTION
ROUTINE AND
SELECT MY OWN
CELESTIAL
BODY?

• Y • N

MANEUVER
VEHICLE UN-
TIL A SUIT-
ABLE CEL-
ESTIAL BODY
IS ACQUIRED

KEY IN PRO-
CEED

WAIT FOR KEY-
BOARD ENTRY

C 378

379

427
P54/SKYLARK

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR RE-
CYCLE.

.P
.R
.D
.C
.Y
.E
.L
.E

KEY IN RE-
CYCLE
V32E

SELECT STAR #1

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY SOURCE CODE
AND CELESTIAL BODY

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY

#730

#740

#750

#760

#770

P54/SKYLARK

3003

C2N

Pl-18

313

NOTE:

1

WAIT

TLS-

Y.

UN 3

2

CELESTIAL BODY CODE
MUST FALL WITHIN
THE LEGAL RANGE
OR AN OPERATOR
ERROR WILL
RESULT

#830

DO I WISH TO
CHANGE THE CODE?

.N .Y

#840

KEY IN V21E
AND CHANGE
CODE.

#850

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.NEW .P
.DATA .R
. .O
. .C
. .E
STORE NEW DATA .E
.D

#860

IS CELESTIAL BODY
CODE NEGATIVE?

.Y .N

#870

#880

#890

#900

#910

#920

TURN ON
OPERATOR
ERROR LIGHT.

IS CELESTIAL BODY
CODE >47 (OCTAL)?

IS C=1
(ATM SUN SENSOR)?

IS DE=46
(SUN)?

TURN ON
OPERATOR
ERROR LIGHT.

z.
y.

$$\begin{matrix} \gamma. \\ z. \end{matrix}$$
$$\begin{matrix} \gamma. \\ z. \end{matrix}$$

CALCULATE CEL-

FLASH VERB-NOUN
TO REQUEST RE-
SPONSE AND DIS-
PLAY PLANET
POSITION
VECTOR:
V06N88
R1-X PL
R2-Y PL

Y.

MONITOR DSKY:
OBSERVE VERB-NOJN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF PLANET POSITION
VECTOR.

016#

R3-Z PL

X PL - THE X
COMPONENT OF
UNIT POSI-
TION VECTOR OF
THE PLANET AT
GET. IN REFER-
ENCE COORDINA-
TES. TO THE
FIFTH PLACE
(.XXXXX).

Y PL - SAME AS
X PL FOR Y
COMPONENT.

Z PL - SAME AS
X PL FOR Z
COMPONENT.

WAIT FOR KEY-
BOARD ENTRY

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR NEW
DATA.

.P .NEW
.R .DATA
.O .
.C .
.E .
.E STORE NEW
.D DATA

DO ALTERNATE LOS
SIGHTING MARK
ROUTINE (R55).

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y .N

KEY IN
PROCEED

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

DO ALTERNATE LOS
SIGHTING MARK
ROUTINE (R56).

#980

#990

#1000

#1010

#1020

#1030

#1040

#1050

#1060

#1070

HAVE TWO CELESTIAL BODIES BEEN MARKED?

.N .Y

IF SUCCESSFUL STAR SELECTION ROUTINE USED, SELECT STAR #2

DO SIGHTING DATA DISPLAY ROUTINE (R54)

.EXIT .EXIT
"B" "A"

DC GYRO TORQUING ROUTINE (R55)

DO SIGHTING DATA DISPLAY ROUTINE (R54)

.EXIT .EXIT
"B" "A"

DO GYRO TORQUING ROUTINE (R55)

#1090

#1100

#1110

#1120

ATM STAR TRACKER GIMBAL ANGLE PROGRAM (P55)

REV 01 03/20/72

PURPOSE:

(1) TO COMPUTE AND DISPLAY THE GIMBAL ANGLES REQUIRED BY THE ATM STAR TRACKER IN ORDER TO POINT AT A DESIRED CELESTIAL BODY.

ASSUMPTIONS:

(1) THE ATM ORIENTATION DETERMINATION PROGRAM (P50) HAS BEEN USED PRIOR TO THE SELECTION OF THIS PROGRAM TO DETERMINE THE ATM SENSOR ATTITUDE VECTORS (Y - ATM AND Z - ATM).

(2) TWO OPTIONS ARE AVAILABLE:

(A) OPTION 1 - USES IMU ORIENTATION TO DETERMINE ATM STAR TRACKER GIMBAL ANGLES

(B) OPTION 2 - USES CSM OPTICS MARK AND LOS TO SUN TO DETERMINE ATM STAR TRACKER GIMBAL ANGLES

(3) THE ASTRONAUT IDENTIFIES THE CELESTIAL BODY TO BE ACQUIRED BY THE STAR TRACKER. SUN OR EARTH ARE NOT TO BE SELECTED AS CELESTIAL BODIES FOR THE STAR TRACKER.

(4) THE IMU MAY BE:

(A) ON AND ALIGNED (FOR OPTION 1)

(3) OFF (FOR OPTION 2)

(5) ATM MUST BE IN SOLAR INERTIAL ATTITUDE IN ORDER TO USE OPTION 2.

(6) THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY.

(7) THE FORMAT OF N19 (OCTAL AZIMUTH ANGLE) IS SUITABLE FOR LOADING DIRECTLY INTO ATM COMPUTER.

(8) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED INTO N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

(9) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY USKY ENTRY.

PRECEDING PAGE BLANK NOT FILMED

#10

Preceding page blank

PRG
CONT

CYC

GROUND

CREW

• CREW
• PROG
• SELECTION
•
•
•
•

DO NOT TO START ATM
STAR TRACKER GIMBAL
ANGLE PROGRAM (P55).
DISPLAY PROGRAM 55

KEY IN ATM STAR
TRACKER GIMBAL ANGLE
PROGRAM (P55).
V37E 55E

•
•
•
•
•
•
•

WAIT FOR KEYBOARD
ENTRY.

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

KEY IN V22E AND
LOAD THE DESIR-
ED SENSOR CODE
IN R2

P. NEW
R. CODE
G.
C.
E.
F.
D. STORE NEW
CODE

WAS CODE 00001
SELECTED?

IS CELESTIAL BODY-
IMU ORIENTATION
OPTION (00001)
STORED?

.N .Y

.Y .N
(00001) (00002)

#100

DO SIGHTING MARK
ROUTINE (R53)

DO SIGHTING MARK
ROUTINE (R53)

CALCULATE LOS VECTOR
TO SUN IN BASIC

#110

PLANET POSITION
VECTJR;
V06N88
R1-X PL
R2-Y PL
R3-Z PL

X PL - THE X
COMPONENT OF UNIT
POSITION VECTOR
OF THE PLANET AT
GET. IN REFERENCE
COORDINATES. TO
THE FIFTH PLACE
(.XXXX).

Y PL - SAME AS
X PL FOR Y
COMPONENT.

Z PL - SAME AS
X PL FOR Z
COMPONENT.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW
DATA.

P NEW
R DATA
D
C
E STORE NEW
D DATA

RESPONSE AND DIS-
PLAY OF PLANET
POSITION VECTOR.

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y .N

KEY IN
PROCEED

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

#180

#190

#200

#210

#220

[illegible]

395

443
P55/SKYLARK

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P
.DATA
.R
.D
.C
.E
STORE NEW
DATA

IS CELESTIAL
BODY CODE
NEGATIVE?

.Y .N

TURN ON
OPERATOR ERROR
LIGHT

IS CELESTIAL
BODY CODE >47
(OCTAL)?

.Y .N

TURN ON
OPERATOR ERROR
LIGHT

KEY IN V21E
AND CHANGE
CELESTIAL BODY
CODE

#280

#290

#300

#310

#320

P55/SKYLARK

#330

03E*

#350

1360

#370

P55/SKYLARK

396

IS CELESTIAL BODY
CODE 00 (PLANET)?

$$\begin{matrix} y \\ z \end{matrix}$$

IS CELESTIAL BODY
CODE 46 OR 47?
(IT IS ASSUMED
THAT THE ASTRO-
NAUT WILL NEVER
SELECT CODES 46
OR 47 FOR STAR
TRACKER)

• N
• (STAR)

OBTAIN STAR
VECTOR FROM
STORED
EPHEMERIS

CALCULATE
VECTOR TO
DESIGNATED
CELESTIAL BODY

FLASH VERB--NOUN TO
REQUEST RESPONSE
AND DISPLAY PLANET
POSITION VECTOR:

POSS
HOLD
- - -
SNAP

MONITOR DSKY:
OBSERVE VERB-NOJN
FLASH TO REQUEST
RESPONSE AND DISPLAY

V06 N88
R1 - X PL
R2 - Y PL
R3 - Z PL

X PL-THE X COMPO-
NENT OF THE UNIT
POSITION VECTOR OF
THE PLANET AT GET
IV BASIC REFERENCE
COORDINATES. TO
THE FIFTH PLACE
(.XXXXX)

Y PL-SAME AS X PL
FOR Y COMPONENT

Z PL-SAME AS X PL
FOR Z COMPONENT.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW
DATA

.P .NEW
.R .DATA
.D .
.C .
.E .
.E .STORE NEW
.D .DATA

OF PLANET POSITION
VECTOR

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y .N

KEY IN PROCEED

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

#380

#390

#400

#410

#420

0330

0440

0545

#460

02カネ

398

P55/SKYLARK

0658

0098

```
--DU ROUTINE R00--      --DJ ROUTINE R0J--  
.  
. . . . .  
  
.  
.....  
.  
.  
.  
.  
..  
..  
EXIT  
P55
```

#620

P55/SKY LARK

CHANGE CONTROL NOTES

REV 00 PCR 036, PCN 438
REV 01 PCR 460, PCN 499

REV 00 05/19/71

ENTRY-PREPARATION PROGRAM (P61)

PURPOSE: (1) TO START NAVIGATION, CHECK IMU ALIGNMENT, AND PROVIDE ENTRY MONITOR SYSTEM INITIALIZATION DATA.

ASSUMPTIONS: (1) THE PROGRAM IS ENTERED WITH ADEQUATE FREE FALL TIME TO COMPLETE THE PREPARATIONS FROM A WORST CASE STARTING ATTITUDE.

(2) THE ISS IS ON AND PRECISELY ALIGNED TO A SATISFACTORY ORIENTATION.

(3) THE PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW

•CREW PROG
•SELECTION
.
...
.

DO R00 TO START
ENTRY-PREPARATION
PROGRAM (P61)
DISPLAY PROGRAM 61

KEY IN ENTRY-PREPAR-
ATION PROGRAM
(P61)
V37E 61E

#10

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 61

#20

DO IMU STATUS CHECK
ROUTINE (R02)

DO IMU STATUS CHECK
ROUTINE (R02)

• • • • •

```
DO STATE VECTOR  
INTEGRATION (MID TO  
AVE) ROUTINE (R41)
```

DO STATE VECTOR
INTEGRATION (MID T3
AVE) ROUTINE (R41)
OBSERVE THAT THE
COMPUTER ACTIVITY
LIGHT IS ON UNTIL
COMPLETION OF ROU-
TINE 41.

CALL AVERAGE G
ROUTINE

○ケネ

IS UNIT (V X R) -
WITHIN 30 DEG OF
+Y?
-SM

05*

[illegible]

09#

POSS
TEMP
HOLD
SNAP

```

. COMMAND PROGRAM
. ALARM AND
. DISPLAY
. V05 N09
. R1-
. R2-
. R3-
. EXPECTED ALARM
. CODE AT THIS
. TIME IS 01427

```

OBSERVE PROGRAM
ALARM LIGHT ON DSKY
AND DISPLAY OF ERROR
CODE (IMU RE-
VERSED. ZERO ROLL
ON F041 BALL WILL
MEAN LIFT DOWN).

A 10x10 grid of dots. A dashed line is drawn between the top row and the bottom nine rows, indicating a separation between the two groups.

80

HEADS UP/DOWN -
DEFINES ENTRY ROLL
ATTITUDE
+0001 FOR HEADS UP/
LIFT DOWN
-0001 FOR HEADS DOWN
/LIFT UP

#130

AM I SATISFIED WITH
THESE VALUES?

.Y .N
. .
. .

#140

WAIT FOR KEYBOARD
ENTRY

KEY IN PROCEED

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW DATA

KEY IN
V25E
AND LOAD
DESIRED
PARAMETERS

#150

P. NEW
R. DATA
O. .
C. .
E. .
E. STORE DATA
D. .

#160

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY:
V06 N60
R1 - G MAX
R2 - VPRED
R3 - GAMMA EI

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF G MAX, VPRED AND
GAMMA EI

#170

HOLD .
SNAP .
G MAX - MAX PREDICTED.

407

457
P61/SKYLARK

G FOR FREE FALL AND.
ENTRY AT NOMINAL
BANK ANGLE (L/D =
.13) IN GS TO
NEAREST .01 G.

VPRED- PREDICTED
INERTIAL VELOCITY
AT 400,000 FT
ALTITUDE ABOVE
THE FISCHER
ELLIPSOID.
IN FPS TO NEAREST
FPS.

GAMMA EI - FLIGHT
PATH ANGLE. ANGLE
BETWEEN INERTIAL
VELOCITY AND THE
LOCAL HORIZONTAL
AT THE ENTRY INTER-
FACE ALTITUDE AT
400,000 FT ALTIT-
UDE ABOVE THE
FISCHER ELLIPSOID.
IN DEGREES TO
NEAREST .01 DEG.

MINUS INDICATES
FLIGHT PATH IS BELOW
THE HORIZONTAL PLANE.

RECORD DATA IF
NECESSARY

#180

#190

#200

#210

#220

P61/SKYLARK

#230

KEY IN PROCEED

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED

.PRO

#240

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF EMS INITIALIZA-
TION PARAMETERS

FLASH VERB-NOUN
TO REQUEST RESPONSE
AND DISPLAY:
VI6 N63
R1 - RTJGO
R2 - VIO
R3 - TFE

#250

AM I SATISFIED WITH
THE VALUE FOR TFE?

RTJGO - RANGE TO GO
FROM A PRELOADED
ALTITUDE (SEE NOTE)
ABOVE THE FISCHER
ELLIPSOID TO THE
SPLASH POINT. IN
NAUTICAL MILES TO
NEAREST .1 NM.

#260

RECORD DATA FOR
EMS INITIAL-
IZATION

VIO - PREDICTED
INERTIAL VELOCITY
AT A PRELOADED AL-
TITUDE (SEE NOTE)
ABOVE THE FISCHER
ELLIPSOID IN FPS TO
NEAREST FPS.

#270

TFE - TIME FROM NOW
TO A PRELOADED ALT-
ITUDE (SEE NOTE)
ABOVE THE FISCHER
ELLIPSOID IN MIN

AND SEC TO NEAREST
SEC. MAX READING IS
59859. -ABOVE +
BELOW ALTITUDE.
YFE IS DECREMENTED
AT A 2 SECOND RATE,
CONTINUING UNTIL
.05G IS SENSED.

NOTE: THE ALTITUDE
IS PRELADGED IN
ERASABLE.
TYPICAL VALUE =
284,643 FT.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

.P
.R
.E
.D
.C
.Y
.C
.E
.L
.E
.D
.....

TERMINATE PROGRAM
61 AND GO ON TO
ENTRY - CM/SM SEP-
ARATION AND PRE-
ENTRY MANEUVER
PROGRAM (P62)

MONITOR DSKY:
OBSERVE TERMINATION
OF P61 AND DISPLAY
OF P62

#280

#290

#300

#310

#320

.....

SWITCH TO ENTRY
DOWNLIST

.....
EXIT P61

#330

.....
EXIT P61

CHANGE CONTROL NOTES

REV 00 PCN 410

WITHIN 30 DEG OF
-Y ?
-SM

.Y .N

POSS
TEMP
HCLD
.....
SNAP

COMMAND PRO-
GRAM ALARM AND
DISPLAY
V05 N09
R1-
R2-
R3-

EXPECTED ALARM
CODE AT THIS
TIME IS 01427

POSS
TEMP
HCLD
.....
SNAP

COMMAND PROGRAM
ALARM AND DIS-
PLAY
V05 N09
R1-
R2-
R3-

EXPECTED ALARM
CODE AT THIS
TIME IS 01426

WAIT 10 SEC

INITIALIZE ENTRY DAP
AND BODY ATTITUDE

OBSERVE PROGRAM
ALARM LIGHT ON DSKY
AND DISPLAY OF ERROR
CODE (IMU REVERSED.
ZERO ROLL ON FDI
BALL WILL MEAN LIFT
DOWN.)

OBSERVE PROGRAM
ALARM LIGHT ON DSKY
AND DISPLAY OF ERROR
CODE (IMU UNSATIS-
FACTORY)

#80

#90

#100

#110

#120

#170

TO PREVENT
RCS ACTIVITY
IMMEDIATELY
AFTER SEPA-
RATION

#180

MOVE CM/SM
SEP SWITCH TO
UP ON CREW
SAFETY PANEL

#190

WHEN SATISFIED THAT
CM/SM SEPARATION
HAS SATISFACTORILY
OCCURRED WAIT -- SEC
FOR ADEQUATE SEPARA-
TION DISTANCE AND
KEY IN PROCEED.

#200

WAIT FOR KEYBOARD
ENTRY
TERMINATE FLASH UPON
RECEIPT OF PROCEED.

.P
.R
.O
.C
.E
.E
.D

TURN OFF CSM
RCS JAP

#210

#230

042番

250

0924

01270

P62/SKYLARK

416

TURN ON ENTRY DAP
AND MAINTAIN ATTITUDE HOLD.

HOLD

SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STORED DATA
V06 N61
R1-IMPACT LAT
R2-IMPACT LONG
R3-HEADS UP/DOWN

IMPACT LAT - LATI-
TITUDE OF DESIRED IM-
PACT POINT. IN
DEGREES TO NEAREST
.01 DEG. + IS NORTH

IMPACT LONG - LONG-
ITUDE OF DESIRED IM-
PACT POINT. IN
DEGREES TO NEAREST
.01 DEG. + IS EAST

HEADS UP/DOWN - DE-
FINES ENTRY ROLL
ATTITUDE
+00001 FOR HEADS UP/
LIFT DOWN
-00001 FOR HEADS
DOWN/LIFT UP

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF S/C ENTRY DATA

AM I SATISFIED WITH
THESE VALUES?

$$z, y.$$

KEY IN PROCEED

KEY IN V25E AND
LOAD DESIRED

PARAMETERS

P. NEW
R. DATA
O. .
C. .
E. .
E. STORE DATA
D. .

#280

#290

#300

#310

#320

IS THE ANGLE ALPHA
ALREADY WITHIN 45
DEGREES?

.Y .N

TEMP
HOLD
MON

DISPLAY ON DSKY DE-
SIRED FINAL GIMBAL
ANGLES:

V06 N22
R1- JG ROLL
R2- JG PITCH
R3- NG YAW

IN DEGREES TO
NEAREST .01 DEG.

WAIT UNTIL CM
ANGLE OF ATTACK
(ALPHA) IS WITH-
IN 45 DEGREES
AND THEN WAIT
AN ADDITIONAL
21 SECONDS.

TERMINATE PROGRAM
62 AND GO TO ENTRY-
INITIALIZATION
PROGRAM (P 63)

MONITOR DSKY:
OBSERVE DISPLAY
OF FINAL GIMBAL
ANGLES.

MONITOR DSKY:
OBSERVE TERMINATION
OF P 62 AND DISPLAY
OF P 63

#330

#340

#350

#360

#370

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#10

P63/SKYLARK

REV 00 05/19/71

ENTRY-INITIALIZATION PROGRAM (P63)

PURPOSE:

- (1) TO INITIALIZE THE ENTRY EQUATIONS.
- (2) TO CONTINUE TO HOLD THE CM TO THE CORRECT ATTITUDE WITH RESPECT TO THE ATMOSPHERE FOR THE ONSET OF ENTRY DECELERATION.
- (3) TO ESTABLISH ENTRY DSKY DISPLAYS.
- (4) TO SENSE .05G AND DISPLAY THIS EVENT TO THE CREW BY SELECTING THE ENTRY-POST 0.05G PROGRAM (P64).

- ASSUMPTIONS:
- (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY-CM/SM SEPARATION AND PRE-ENTRY MANEUVER PROGRAM (P62).
 - (2) IN ADDITION TO N64(G, VI, R TO GO) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN VI6NXXE:
 N63 (RTGGO, VIO, TFE)
 N68 (BETA, VI, HDOT)
 N74 (BETA, VI, G)

PROG
CONT

CREW

GROUND

CMC

.CMC PROG
.SELECTION

...

START ENTRY -
INITIALIZATION
PROGRAM (63)
DISPLAY PROGRAM 63

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 63

...

PERFORM ENTRY
INITIALIZATION

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MONITOR DSKY:
OBSERVE DISPLAY OF
G. VI AND R TO GO

• • • • •

G-ACCELERATION IN G
TO NEAREST .01G

VI-INERTIAL VELOCITY
IN FPS TO NEAREST
FPS

R TO GO -- RANGE TO
GO TO THE DESIRED
SPLASH POINT
ASSUMING SPLASH
POINT LOCATED AT
CALCULATED IMPACT
TIME. IN NAUTICAL
MILES TO NEAREST
.1 NM. NEGATIVE AND
COUNTING DOWN WHEN
APPROACHING TARGET,
POSITIVE AND COUNT-
ING UP WHEN LEAVING
TARGET.

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. .
. .
. .
. .
. .
. .

WAIT FOR .05G
INDICATION

.
. .

ENTRY LOGIC DETECTS
.05G

.
. .

CHANGE ENTRY DAP
FROM ATTITUDE HOLD

MONITOR GNCS CONTROL
OF PRE -- .05G CM
ATTITUDE:

(1) DSKY:

R1-G-INCREASING

R2-VI-NOMINAL

R3-R TO GO
NEGATIVE AND
COUNTING DOWN
WHEN APPROACHING
TARGET, POSITIVE
AND COUNTING UP
WHEN LEAVING
TARGET.

(2) FDI:

ATTITUDE RATES
LESS THAN--DEG./
SEC.

ATTITUDE ERRORS
LESS THAN --DEG.

#80

#90

#100

#110

• • • • •

• • •

• • • •

425

477
P63/SKYLARK

CHANGE CONTROL NOTES

P63/SKYLARK

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ENTRY - POST 0.05 G PROGRAM (P64) REV 00 05/19/71

PURPOSE:

- (1) TO START ENTRY GUIDANCE AT .05G SELECTING ROLL ATTITUDE, CONSTANT DRAG LEVEL, AND DRAG THRESHOLD, KA, WHICH ARE KEYED TO THE .05G PJINT.
- (2) SELECT FINAL PHASE (P67) WHEN 0.2G OCCURS IF V WAS <27000 FPS AT 0.05G.
- (3) ITERATE FOR UPCTRL SOLUTION (P65) IF V >27000 FPS AND IF ALTITUDE RATE AND DRAG LEVEL CONDITIONS ARE SATISFIED
- (4) SELECT FINAL PHASE (P67) IF NC UPCONTROL SOLUTION EXISTS WITH VL >18000 FPS.
- (5) TO ESTABLISH THE 0.05 G MODE IN SCS.
- (6) TO CONTINUE ENTRY DSKY DISPLAYS.

ASSUMPTIONS: (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY INITIALIZATION PROGRAM (P 53).

- (2) IN ADDITION TO N74 (BETA, VI, G) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN VL6NXXE:
N64 (G, VI, R TO GO)
N68 (BETA, VI, HDOT)

PROG
CONT

CREW

GROUND

CMC

CMC PROG.
SELECTION

START ENTRY-POST
0.05 G PROGRAM
(P 64)

DISPLAY PROGRAM 64

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 64

#10

#20

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TEMP
HOLD
.....
MCN

DISPLAY ON DSKY:
V06 N74
R1-BETA
R2-VI
R3-G

BETA-COMMANDED BANK
ANGLE. IN DEGREES
TO NEAREST .01
DEGREE

VI - INERTIAL
VELOCITY. IN FPS TO
NEAREST FPS

G-ACCELERATION IN G
TO NEAREST .01G.

SET 0.05 G ENTRY
SWITCH ON SCS
CONTROL PANEL TO ON

MONITOR G+N CONTROL
OF ENTRY:
(A) F0AI:
ATT ERRORS LESS
THAN --DEG

ATT RATES LESS
THAN --DEG/SEC
BALL INDICATES
LIFT VECTOR
DIRECTION COR-
RELATION WITH
BETA

(B) DSKY:
R1-BETA VARIES
TO LIMIT G AND
CONTROL LIFT
VECTOR

R2 - VI
DECREASING
R3-G- INCREASING

COMMAND CM ATTITUDE
IN ACCORDANCE WITH
CMC ENTRY LOGIC

#30

#40

#50

#60

429

481
P64/SKYLARK

040

第80

06*

EXIT P64

```

TERMINATE P64 AND GO
TO ENTRY-UP CONTROL
PROGRAM (P65)
IF V EQUAL TO OR
GREATER THAN 27000
FPS AND CONSTANT
DRAG CONTROL HAS
BROUGHT RANGE PRE-
DICTION TO WITHIN
25 NM OF DESIRED
RANGE. IF V < 27000
FPS AT .05G, THEN
WHEN .2G IS REACHED
THE DSKY WILL DIS-
PLAY P67

```

EXIT P64

CHANGE CONTROL NOTES

P64/SKYLARK

431

483

REV 00 05/19/71

ENTRY - UP CONTROL PROGRAM (P65)
 NOTE: P65 HAS NOT BEEN TESTED AND IS
 THEREFORE NOT OPERATIONAL FOR SKYLARK.

PURPOSE:

- (1) TO EXECUTE ENTRY - JP CONTROL GUIDANCE WHICH STEERS THE CM TO A CONTROLLED EXIT (SKIP OUT) CONDITION.
- (2) TO ESTABLISH ENTRY - UP CONTROL DISPLAYS WHICH ARE USED IN CONJUNCTION WITH THE EMS TO DETERMINE FOR THE ASTRO-NAUT IF THE BACKUP PROCEDURES SHOULD BE IMPLEMENTED.
- (3) TO SENSE EXIT (DRAG ACCELERATION LESS THAN Q7 FPS) AND THEREUPON TO SELECT THE ENTRY - BALLISTIC PROGRAM (P66).
- (4) WHERE ROOT IS NEGATIVE AND THE V IS SUFFICIENTLY LOW (V-VL-C18 VE3), PROGRAM WILL EXIT DIRECTLY TO P67 (FINAL PHASE).

ASSUMPTIONS:

- (1) THIS PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY - JUST 0.053 PROGRAM (P64) WHEN CONSTANT DRAG CONTROL HAS BROUGHT RANGE PREDICTION TO WITHIN 25 N.M. OF THE DESIRED RANGE. IT IS SKIPPED IN EARTH ORBIT MISSIONS.
- (2) IN ADDITION TO N74 (BETA, VI, G) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN VI6NXXE:
 N64 (G, VI, R TO GO)
 N68 (BETA, VI, HDOT)
- (3) MANUAL RESPONSE TO N69 IS NOT NECESSARY TO TERMINATE P65. SELECTION OF EITHER P66 OR P67 BY ENTRY GUIDANCE PROVIDES AUTOMATIC TERMINATION.

PROG
CONT

CREW

GROUND

CMC

•CMC PROG
 •SELECTION
 .
 .
 .

START ENTRY - UP
 CONTROL PROGRAM (65)

#10

MONITOR DSKY:
 OBSERVE DISPLAY OF
 PROGRAM 65

DISPLAY PROGRAM 65

#20

P65/SKYLARK

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HOLD .
MON .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY PRE-COMPUTED
EXIT CONDITIONS
V16 V69
R1 - BETA
R2 - DL
R3 - VL

BETA - COMMANDED
BANK ANGLE. IN DEG-
REES TO NEAREST 0.01
DEGREE

DL - DRAG ACCELE-
TION AT SKIP OUT IN
GS TO NEAREST
0.01 G (Q7)

VL - SKIP OUT
VELOCITY. IN FPS TO
NEAREST FPS.

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST RE-
SPONSE AND DISPLAY
OF BETA, DL, AND VL

RECORD CONTENTS OF
R1, R2, AND R3 FOR
LATER USE WITH EMS

DO EITHER:
WAIT FOR KEYBOARD
ENTRY
TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR FLASH IS AUTO-
MATICALLY TERMINATED
UPON RECEIPT BY
ENTRY GUIDANCE OF
P66 OR P67.

KEY IN PROCEED

P
R
O
C
E

#70

#80

#90

#100

#110

TEMP
HOLD

MON

DISPLAY ON DSKY:

V06 N74

R1 - BETA

R2 - VI

R3 - G

BETA - COMMANDED
BANK ANGLE. IN
DEGREES TO NEAREST
0.01 DEGREE

VI - INERTIAL VELO-
CITY. IN FPS TO
NEAREST FPS

G-ACCELERATION IN G
TO NEAREST .01G

MONITOR GEN CONTROL
OF ENTRY:

(A) FDAI:

ATT ERRORS LESS

THAN -- DEG

ATT RATE LESS

THAN -- DEG/SEC.

(B) DSKY:

R1 - BETA VARIES
TO LIMIT G AND
CONTROL LIFT
VECTOR

R2-VI DECREASING

R3-G-DECREASING
(G MAY INCREASE
INITIALLY IF IT
IS NECESSARY TO
FLY DOWN TO THE
BEGINNING OF THE
REFERENCE
TRAJECTORY.)

COMMAND CM ATTITUDE
IN ACCORDANCE WITH
CMC ENTRY LOGIC

#120

...

#130

• • • •

0140

• • • • •

#150

• • •

EXIT P65

#160

435

487
P65/SKYLARK

CHANGE CONTROL NOTES

P65/SKYLARK

ENTRY - BALLISTIC PROGRAM (P66)
 NOTE: P66 HAS NOT BEEN TESTED AND IS
 THEREFORE NOT OPERATIONAL FOR SKYLARK.

REV 00 05/19/71

- PURPOSE:
- (1) TO MAINTAIN CM ATTITUDE DURING BALLISTIC (SKIP OUT) PHASE FOR ATMOSPHERIC RE-ENTRY.
 - (2) TO SENSE RE-ENTRY (DRAG ACCELERATION BUILDS UP TO Q7F + 0.5 FPS OR APPROX. 0.2G) AND THEREUPON TO SELECT THE ENTRY - FINAL PHASE PROGRAM (P67).

ASSUMPTIONS: (1) THIS PROGRAM IS AUTOMATICALLY SELECTED BY THE ENTRY - UP CONTROL PROGRAM (P65) WHEN DRAG ACCELERATION BECOMES LESS THAN Q7 FPS.

- (2) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN V16NXXE:
- N64 (G, VI, R TO GO)
 - N68 (BETA, VI, HOOT)
 - N74 (BETA, VI, G)

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PROG
CONT

CREW

GROUND

CMC

.CMC PROG
.SELECTION

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START ENTRY - BAL-
LISTIC PROGRAM (P66)

DISPLAY PROGRAM 66

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 66

#20

#30

#40

#50

#60

ESTABLISH ATTITUDE
COMMANDS FOR ENTRY
DAP NECESSARY TO
GIVE CORRECT ANGLE
OF ATTACK INTO THE
ATMOSPHERE:
ROLL COMMAND--
MAINTAIN LAST
COMPUTED VALUE
FROM ENTRY
GUIDANCE UNLESS
ACCELERATION GOES
BELOW .05 G IN
WHICH CASE MAIN-
TAIN ZERO DEGREES
UNTIL TERMINATION
OF P66.
ALPHA COMMAND--
TRIM ANGLE OF
ATTACK (TRIM
ALPHA)
BETA COMMAND--
ZERO.

CALCULATE FINAL
GIMBAL ANGLES RE-
QUIRED BASED ON PRE-
SENT STATE VECTOR.
REPEAT CALCULATION
EVERY TWO SECONDS
UNTIL TERMINATION OF
P66.

TEMP
HOLD .

MON .

DISPLAY ON DSKY:
THE DESIRED GIMBAL
ANGLES TO WHICH THE
ENTRY DAP WILL ORI-
ENT THE CM

.....
MONITOR GNCS CONTROL
OF ENTRY:
.....

FOAI: ATTITUDE
ERROR NEEDLES -
DIFFERENCE BETW-
EEN THE TOTAL DE-
SIRED ATTITUDE
AND THE ACTUAL
ATTITUDE (FLY TO
POLARITY).

• • • • •

ROLL ANGLE IS HELD
AT LAST COMPUTED
VALUE FROM ENTRY
GUIDANCE UNLESS
ACCELERATION GOES
BELOW 0.05G IN WHICH
CASE ZERO DEGREES IS
HELD UNTIL TERMINA-
TION OF P66.
PITCH AND YAW
ATTITUDE IS DETER-
MINED BY THE VEHICLE
POSITION AND VELO-
CITY W.R.T. THE
ATMOSPHERE. THIS
ATTITUDE IS ZERO
SIDESLIP AND ANGLE
OF ATTACK NEAR THE
TRIM VALUE.

NOTE: THREE AXIS DAP
CONTROL WAS REGAINED
WHEN LESS THAN 0.05
G WAS SENSED AND

BALL: ACTUAL GIMBAL
ANGLES READ ON BALL
SHOULD AGREE WITH
COMMANDED GIMBAL
ANGLES READ ON DSKY.

.....

01

080

06#

#100

0110

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• • • •

EXIT P66

•

ENTRY - FINAL PHASE PROGRAM (P67)

1.7/61/50 00 A32

PURPOSE:

(1) TO CONTINUE ENTRY GUIDANCE AFTER QTF + 0.5FPS² (OR APPROX. 0.2G) UNTIL TERMINATION OF STEERING WHEN THE CM VELOCITY WRT EARTH = 1000 FT/SEC (ALTITUDE IS APPROXIMATELY 65,000 FT.).

(2) TO CONTINUE ENTRY DSKY DISPLAYS.

ASSUMPTIONS: (1) THE PROGRAM IS AUTOMATICALLY SELECTED BY:

(A) P65 WHEN RDOT IS NEGATIVE AND THE V IS SUFFICIENTLY LOW (V-VL-CI8 NEG)

(B) P66 WHEN DRAG ACCELERATION BUILDS UP TO QTF + 0.5 FPS. (DR APPROX. 0.2G)²

(C) P64 IF NO UPCONTROL SOLUTION EXISTS WITH VL > 18000 FPS

(2) THE ASTRONAUT MAY MONITOR THE FOLLOWING NOUNS BY KEYING IN V16NXE:

N64 (G, VI, R TO GO)

N68 (BETA, VI, HDOY)

N74 (BETA, VI, G)

PROG
CONT

CMC

GROUND

CREW

•CMC PROG.
•SELECTION

•

•

START ENTRY-FINAL
PHASE PROGRAM (P 67)

•

•

DISPLAY PROGRAM 67

MONITOR DSKY:
OBSERVE DISPLAY OF
PROGRAM 67

•

•

•

•

•

•

•

•

TEMP

DISPLAY ON DSKY:

V06 V66

R1-BETA

R2-X RNG ERR

R3-DWN RNG ERR

MONITOR G+N CONTROL
OF ENTRY:

(A)FDAI:

ATT ERRORS LESS
THAN --DEG
ATT RATES LESS
THAN --DEG/SEC.

BETA-COMMANDED
BANK ANGLE. IN
DEGREES TO NEAREST
.01 DEGREE.

X RNG ERR - CMC
SOLUTION FOR CROSS
RANGE ERROR. POS-
ITIVE IF TARGET ON
THE SOUTH SIDE OF
TRAJECTORY PLANE.
NEGATIVE IF ON THE
NORTH SIDE OF
TRAJECTORY PLANE.
IN NAUTICAL
MILES TO THE NEAR-
EST .1 NM.

DWN RNG ERR - CMC
SOLUTION FOR DOWN
RANGE ERROR (DEC-
REASING) POSITIVE
FOR OVERSHOOT,
NEGATIVE FOR UN-
DERSHOOT. IN NAUT-
ICAL MILES TO
NEAREST .1 NM.
(PREDANGLE-THETA)
NOTE: THE DWN RNG
ERR DISPLAY WILL
BE 9999.9 NM ONCE
THE TARGET HAS
BEEN OVERSHOT.

R3- DWN RNG ERR
- DECREASING

#30

#40

#50

#60

#70

#80

#90

#100

#110

#120

P67/SKYLARK

.

 COMMAND C4 ATTITUDE
 IN ACCORDANCE WITH
 CMC ENTRY LOGIC

. . .

 WAIT UNTIL CM
 VELOCITY WRT EARTH =
 1000 FPS

. . .

 FLASH VERB-NOUN TO
 REQUEST RESPONSE AND
 DISPLAY:
 V16 N67
 R1-R TO GO
 R2-LAT
 R3- LONG

HOLD.
 MON .

 MONITOR DSKY:
 OBSERVE VERB-NOUN
 FLASH TO REQUEST RE-
 SPONSE AND DISPLAY
 PRESENT POSITION AND
 RANGE TO GO

R TO GO-RANGE TO GO
 TO TARGET. IN NAUTI-
 CAL MILES TO NEAREST
 .1 NM. NEGATIVE AND
 DECREASING WHEN AP-
 PROACHING TARGET,
 POSITIVE AND IN-
 CREASING WHEN LEAV-
 ING TARGET.
 LAT - LATITUDE OF
 PRESENT POSITION. IN
 DEGREES TO NEAREST
 .01 DEG.
 (+ IS NORTH)

LONG - LONGITUDE OF
 PRESENT POSITION. IN
 DEGREES TO NEAREST
 .01 DEG.
 (+ IS EAST)

.

 HOLD CONSTANT ATTI-
 TUDE MANUALLY (FULL
 LIFT UP OR DOWN, DE-
 PENDING ON R TO GO)
 UNTIL CHUTE DEPLOY-
 MENT.

. . .

 MONITOR ALTIMETER
 AND STANDBY TO BACK-

• • •

• • •
•
•

#130

.PRO

• • •

• • • •

EXIT P67

ちちち

CSM VELOCITY VECTOR UPDATE PROGRAM (P77) REV 01 03/20/72

PURPOSE:

(1) TO PROVIDE A MEANS OF NOTIFYING THE CMC THAT THE CM HAS CHANGED (JR WILL CHANGE) ITS ORBITAL PARAMETERS BY THE EXECUTION OF A THRUSTING MANEUVER WHEN AVERAGE G IS NOT RUNNING.

(2) TO PROVIDE TO THE CMC THE DELTA V APPLIED TO THE CM TO ENABLE AN UPDATING OF THE CM STATE VECTOR.

(1) THE CSM CREW HAS THE DELTA V TO BE APPLIED BY THE CM IN LOCAL VERTICAL AXES AT A SPECIFIED TIG.

(2) R03 SHOULD BE PERFORMED AFTER P77 TO UPDATE CSM HEIGHT.

(3) THE CONTENTS OF N81 IS THE SAME AS THE PREVIOUS VALUE OF N81 AT ENTRANCE TO P77.

(4) THIS PROGRAM IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

ASSUMPTIONS:

++
+01
+489
++

PROG
CONT

CMC

GROUND

CREW

.CREW
.PROGRAM
.SELECTION
...

DO R00 TO START CSM
VELOCITY VECTOR UP-
DATE PROGRAM (P77)
DISPLAY P77

KEY IN CSM VELOCITY
VECTOR UPDATE
PROGRAM (P77)
V37E7E

MONITOR DSKY:
OBSERVE DISPLAY
OF PROGRAM 77

#10

#20

F

180

067

每100

#110

#120

P77/SKY LARK

CORRECT ONES
EXECUTED OR TO BE
EXECUTED?

.Y .N

KEY IN
PROCEED

KEY IN V25E
AND LOAD THE
CORRECT DELTA V.

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

PROCEED NEW
DATA

STORE DATA

SET NODFLAG

UPDATE CM STATE
VECTOR TO REFLECT
THE DELTA V ADDED.
DELTA V HAS BEEN
TRANSFORMED FROM
LOCAL VERTICAL INTO
BASIC REFERENCE
COORDINATES.

#130

#140

#150

#160

#170

449

505
PT77/SKYLARK

.....

RESET NODOFLAG

.....

#180

.....

DO ROUTINE R00

.....
.....
EXIT

.....

DO ROUTINE R00

#190

.....
.....
EXIT

CHANGE CONTROL VOTES

REV 01 PCN 489

PT77/SKYLARK

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FINAL AUTOMATIC REQUEST TERMINATE
ROUTINE (R00)

REV 01 03/20/72

PURPOSE:

(1) TO PROVIDE A STANDARD EXIT FOR PROGRAMS, AND AN OPTION TO SELECT ANY PROGRAM DESIRED.

++

(2) TO PROVIDE A GENERAL DESCRIPTION OF THE COMPUTER ACTIVITY FOLLOWING ANY PROGRAM SELECTION.

+01

ASSUMPTIONS:

(1) THE CALLING PROGRAM HAS SUCCESSFULLY COMPLETED ALL ITS FUNCTIONS OR THE OPERATOR HAS PREMATURELY TERMINATED THE PROGRAM OR A P00000 TYPE ABORT (WITHOUT AVERAGE G ACTIVE AND WITH NO EXTENDED VEP3 ACTIVE) HAS OCCURRED.

+489

(A) IF A PROGRAM HAS COMPLETED ALL ITS FUNCTIONS AND MINKEY IS RUNNING (AUTOSE0 SET) CONTROL WILL GO TO THE NEXT POINT IN THE MINKEY CONTROLLER (R07) INSTEAD OF FLASHING V37.

++

(B) PREMATURE TERMINATION OF AN OPERATION WILL TURN OFF MINKEY (RESET AUTOSE0).

(2) THE COMPUTER CHECKS ON THE UNIVERSAL TRACKING PROCESS FOLLOWING ANY V37EXX IN THE FOLLOWING WAYS:

(A) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY RUNNING AND WAS NOT RUNNING IN THE BACKGROUND IT WILL BE STARTED AS A NEW PROGRAM.

(B) IF P20 IS THE NEW PROGRAM KEYED IN AND P20 IS PRESENTLY RUNNING (I.E. 20 DISPLAYED IN THE PROG LIGHTS) IT WILL BE STARTED AS A NEW PROGRAM (I.E. RE-INITIALIZED).

++

(C) IF P20 IS THE NEW PROGRAM KEYED IN AND IS NOT PRESENTLY THE ONLY PROGRAM RUNNING (I.E. A PROGRAM OTHER THAN P20 IS DISPLAYED IN THE PROG LIGHTS) AND P20 IS RUNNING IN THE BACKGROUND THE P20 LIGHTS WILL BE CHANGED TO 20 AND P20 WILL START AT P20 RESTART POINT WITH THE FLAGS SET TO ALLOW TRACKING. IN ADDITION R22 WILL START AT THE R22 RESTART POINT FOR OPTIONS 0,4 AND ALLOW STATE VECTOR UPDATES; P00 TYPE INTEGRATION WILL START IN THE REMAINING OPTIONS.

+01

++

++

++

+489

++

(D) IF P00 IS SELECTED, THE RENDEZVOUS FLAG AND UTFLAG ARE RESET (SHUT OFF P20) AND P00 IS STARTED.

(E) IF A PROGRAM OTHER THAN P20 AND P00 IS KEYED IN, THE NEW PROGRAM WILL BE STARTED AND THE PROG LIGHTS WILL DISPLAY THE NEW PROGRAM. THE COMPUTER WILL THEN ATTEMPT TO RESTART P20 AND WILL BE SUCCESSFUL IF P20 WAS RUNNING IN THE BACKGROUND AND THE NEW PROGRAM WILL ALLOW TRACKING.

(F) IF NEW PROGRAM SELECTED IS P31-P38 AND P20, OPTION 0 OR 4, IS NOT RUNNING, ANY OTHER P20 OPTION WILL BE TERMINATED AND P20 OPTION 0 WILL BE STARTED WITH NOMINAL TRACKING VALUES. NO P20 DISPLAYS WILL APPEAR. IF THE IMJ IS NOT ALIGNED (REFSMAT FLAG SET) P20 WILL NOT BE STARTED.

(3) IF THE IMU IS ALIGNED AND THE NEW PROGRAM SELECTED IS P31-P38, FL V50 N25 RI=17 WILL BE DISPLAYED TO REQUEST CREW TO AUTHORIZE MINKEY SEQUENCE. THIS FLASHING DISPLAY MARKS THE TRANSITION FROM R00 TO MINKEY CONTROLLER (R07).

PROG

CMC

GROUND

CREW

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RESET AUTOSEQ FLAG

NORMAL
ENTRANCE
TO ROO FROM
MINKEY
SELECTED
PROGRAMS

IS TRACK FLAG SET?

YES

NO

IS DOCKED DAP RUNNING?

•NO **•YES**

SET DOCKED
DEADBAND INTO

452

ROO/SKYLARK

CREW.
ROUTINE.
SELECTION.

#10

#20

030

048

DOCKED DAP

#50

IS MAX DB FLAG SET?

.N .Y

#60

SET MAX
DEAD-
BAND IN
RCS DAP

#70

SET MIN DEAD-
BAND IN RCS DAP

#80

COMMAND ZERO RATE
IN RCS JAP (TO
STOP RATE DRIVE
FROM P20)

#90

IS HOLDFLAG
NEGATIVE?

.Y N.

[illegible]

```
FLASH VERB 37 TO  
REQUEST PLEASE PER-  
FORM CHANGE OF  
PROGRAM  
V37 N BLANK  
R1 BLANK  
R2 BLANK  
R3 BLANK
```

R1 BLANK
R2 BLANK
R3 BLANK

• • •

• • • • •

• •

• •

EXIT

• •

• •

• -----
• NO • YES

• • • • •

•

GO TO

•

ROO/SKYLARK

++
+01
+
+
+
+489
++

#250

IS UNIVERSAL
TRACKING (P20) OP-
TION 1, 2 OR 5 ON
(UTFLAG SET)?

.YES .NO
.
.

#260

TURN IT OFF
(RESET JTFLAG)
RESET TRACK
FLAG

#270

++
+01
+
+
+
+489
++

IS UNIVERSAL
TRACKING (P20)
OPTION 3 OR 4 ON
(RENDEZVOUS FLAG
SET)?

.NO .YES
.
.

#280

SET AUTOSEQ
FLAG

#290

START UNIVERSAL
TRACKING PRO-
GRAM (P20),
OPTION 3

459

515
R00/SKYLARK

IS THE ENGINE ON?

.Y .N

TERMINATE THE
ENGINE ON
CCMAND.

TURN OFF TVC
DAP

TURN OFF ALL
RCS TRANSLATION
AND ROTATION

WAIT ABOUT 3
SECONDS

TURN ON RCS DAP

WRITE ZEROS
INTO NEW PROG-
RAM SELECTION

RESELECT V37

EXIT

#360

#370

#380

#390

#400

R00/SKYLARK

SO THAT REGARD-
LESS OF THE
SELECTED PROG-
RAM, R03 WILL
SELECT P00.

#410

IS NEW PROGRAM P00?

.Y .N

IS NODDFLAG SET TO
INHIBIT SELECTION
OF A NEW PROGRAM
OTHER THAN P00?

.N .Y

TURN ON PRO-
GRAM ALARM
LIGHT AND
STORE ALARM
CODE 1520

#430

MONITOR DSKY:
DOES PROGRAM ALARM
LIGHT COME ON, INDI-
CATING THAT NEW
PROGRAM SELECTION IS
NOT PERMITTED AT
THIS TIME?

.N .Y

#440

DOES THE NEW
PROGRAM EXIST?

.Y .N

#450

RESET ALARM
LIGHT AND
WAIT FOR COM-

#510

#520

#530

#540

#550

462

ROO/SKYLARK

STOP RATE DRIVE
FROM P20)

.

IS HOLD FLAG
NEGATIVE?

.Y

N.

SET HOLD FLAG
ZERO

SET DAP REFERENCE
TO DESIRED DAP
CDUS

RESET TARGIFLG

RESET SUBFLAG,
P55.IFLG, P50.IFLG

#560

#570

#580

#590

#600

• • •

• • •

• • •

• • •

• • •

• • •

• • •

• • •

IS NEW PROGRAM P00?

.N .Y

RESET N00FLAG

RESET RENDEZVOUS
FLAG.

RESET UTFLAG

IS NEW PROGRAM P20?

.N .Y

IS THE CURRENT
PROGRAM P20?

.N .Y

IS UTFLAG SET?

.YES .NO

#660

#670

#680

#690

#700

#710

#720

#730

#740

#750

466

R00/SKYLARK

IS RENDEZVOUS
FLAG SET?

.Y .N

ESTABLISH
POO TYPE
INTEGRA-
TION

.N .Y

SET
DOCKED
DEADBAND
INTO
DOCKED
DAP

IS MAXDBFLG
SET?

.NO .YES

SET SET
MIN MAX

DEAD- DEAD-
BAND BAND
IN IN
RCS RCS
DAP DAP

#760

SET UPDATE FLAG

#770

COMMAND
ZERO
VEHICLE
RATE

#780

SET TRACK FLAG

IS HOLDFLAG
NEGATIVE?

#790

SET HOLDFLAG
ZERO

#800

SET DAP REFERENCE
TO DESIRED DAP

810

820

0830

0485

#850

468

ROO/SKYLARK

469 525 R00/SKYLARK

#860

NOTES

REV 00 PCR 003,
REV 01 PCN 489

R00/SKYLARK

ERASABLE AND CHANNEL MODIFICATION
ROUTINE (R01)

REV 00 05/19/71

PURPOSE:

(1) TO PROVIDE MANUAL CAPABILITY OF CHANGING FLAGWORD BITS OR CHANNEL BITS.

ASSUMPTIONS:

(1) THIS PROCEDURE CAN BE PERFORMED AT ANY TIME.

(2) THIS PROCEDURE IS NOT RESTRICTED TO FLAGWORDS OR CHANNELS BUT CAN MODIFY ANY LEGITIMATE ERASABLE LOCATION > 30.

(3) THIS PROCEDURE CANNOT BE USED TO MODIFY CHANNEL 77.

DESCRIPTION:

(1) NOUN 07 MUST BE LOADED BY V25NOTE.

(2) NOUN 07 IS A THREE COMPONENT OCTAL NOUN WITH THE FOLLOWING DEFINITION:

R1 = AN ADDRESS SPECIFYING EITHER THE ECADR OF AN ERASABLE LOCATION OR THE NUMBER OF A CHANNEL:

IF R1>30, THE ADDRESS IS ASSUMED TO BE AN ECADR;

IF R1<30, THE ADDRESS IS ASSUMED TO BE A CHANNEL NUMBER.

AS IN ALL ATTEMPTS TO MODIFY CHANNEL 7, THE REQUEST IS IGNORED IF R1=7.

R2 = UP TO FIVE OCTAL DIGITS SPECIFYING BITS IN THE WORD TO BE SET (E.G.: 200 IS BIT 8).

R3 = POSITIVE NON-ZERO INDICATES A "1" IS TO BE SET INTO BIT POSITIONS SPECIFIED IN R2. ZERO, NEGATIVE,
OR BLANK INDICATES A "0".

(3) AS AN EXAMPLE, SETTING OF BITS 1, 3 AND 13 TO "1" IN FLAGWORD 8 REQUIRES THE FOLLOWING SEQUENCE:

V25NOTE
104E
10005E
1E

RESETTING THE SAME BITS TO "0" REQUIRES THE SEQUENCE:

V25NOTE
104E
10005E
OE

(4) SETTING OF BIT 10 OF CHANNEL 12 TO "1" REQUIRES THE FOLLOWING SEQUENCE:

V25NOTE
12E
1000E
1E

RESETTING THE SAME BIT TO "0" REQUIRES THE SEQUENCE:

V25NOTE
12E
1000E
OE

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CHANGE CONTROL NOTES

○ 4 族

05#

090

021

RO2/SKYLARK

ちんち

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REV 00 05/19/71

CSM DAP DATA LOAD ROUTINE (R03)

PURPOSE:

(1) TO LOAD AND VERIFY CMC DIGITAL AUTOPILOT (DAP) DATA FOR CSM.

(2) TO PROVIDE THE CREW A MEANS FOR SELECTING APPROPRIATE COAST AUTOPILOTS. AFTER COMPLETION OF THIS ROUTINE, WHICH IDENTIFIES THE VEHICLE CONFIGURATION, THE USE OF VERB 46 ENTER (ACTIVATE CSM DAP) WILL CAUSE THE APPROPRIATE DAP TO BECOME ACTIVE. V45 IS NECESSARY TO START NEW DAP MODE: 1) WHEN SWITCHING FROM IDLE MODE TO SATURN OR RCS, 2) WHEN SWITCHING FROM SATURN TO RCS, 3) WHEN SWITCHING FROM SATURN OR RCS TO IDLE MODE.

ASSUMPTIONS:

(1) THE MOMENTS OF INERTIA AND OTHER PERTINENT PARAMETERS ARE STORED IN THE CMC AS A FUNCTION OF THE KEYS IN WEIGHTS.

(2) THE VALUE FOR WEIGHT IS REDUCED LINEARLY AS A FUNCTION OF SPS MANEUVER TIME DURING SPS THRUSTING PROGRAM (P40) MANEUVERS ONLY. ALL THRUSTING MANEUVERS THAT ARE PERFORMED WITHOUT USING P40 COULD CAUSE THE CMC'S KNOWLEDGE OF WEIGHT TO BE COMPROMISED.

(3) THIS ROUTINE IS SELECTED BY THE ASTROVAULT BY DSKY ENTRY.

(4) THIS ROUTINE IS NOT AVAILABLE IF UNDER THRUST VECTOR CONTROL.

PROG
CONT

CMC	GROUND	CREW
		.CREW
		.ROUTINE
		.SELECTION
		.
		...
		.

START CSM DAP DATA
LOAD ROUTINE (R03)

KEY IN V48E

#10

IS TVC DAP ON?

.N

#20

IS ANOTHER EX-
TENDED VERB, A

Preceding page blank

#30

#40

#50

#60

MARKING DISPLAY,
OR A PRIORITY
DISPLAY ACTIVE?

.N .Y

TURN ON OPERATOR
ERROR LIGHT.

EXIT

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY DAP CONFIG-

V04 N46
R1-ABCDE
R2-ABCDE
R3-BLANK

R1 DATA CODE:
A-VEHICLE CONFIG.
CODE:
0-NO DAP
1-CSM

3-S1VB
B-QUAD AC FOR
X TRANS CODE:
0-DON'T USE
QUAD
1-JSE QUAD
C-QUAD BD FOR
X TRANS CODE:
0-DON'T USE

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF DAP CONFIGURATION
DATA

AM I SATISFIED WITH
THE STORED DAP CON-
FIGURATION DATA?

.Y .N

#70

#80

#90

#100

#110

#120

QUAD
1-JSE QUAD
D-DEADBAND CODE:
0-0.5 DEG
1-5.0 DEG
E (LSB)-MANEUVER
RATE CODE:
0-0.05 DEG/SEC
1-0.2 DEG/SEC
2-0.5 DEG/SEC
3-2.0 DEG/SEC
NOTE: IF BOTH B+C
DISPLAY ZERO
THIS MEANS 1-1

R2 DATA CODE:
A-QUAD AC OR BD
ROLL CODE
0-USE BD
1-JSE AC
B-QUAD A CODE
0-DON'T USE
QUAD
1-USE QUAD
C-QUAD B CODE
0-DON'T USE
QUAD
1-USE QUAD
D-QUAD C CODE
0-DON'T USE
QUAD
1-USE QUAD
E-QUAD D CODE
0-DON'T USE
QUAD
1-USE QUAD

WAIT FOR KEYBOARD
ENTRY

KEY IN PRO-
CEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.PROCEED .NEW DATA

KEY IN V21E,
V22E, OR V24E AND
LOAD DESIRED DATA
CODES IN R1, R2

#130

0418

#150

0916

#170

488

R03 / SKYLARK

HOLD .
.....
SNAP .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY CSM WEIGHT:
V06 V47
R1-CSM WEIGHT
R2-XXXX
R3-BLANK

CSM WEIGHT-WEIGHT OF
THE CSM IN POUNDS TO
THE NEAREST POUND.

NOTE: R2 (LM WEIGHT)
NOT APPLICABLE TO
SKYLARK

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF CSM WEIGHT

IS THE CSM
WEIGHT
CORRECT?

.Y .N

KEY IN PROCEED

WAIT FOR KEYBOARD
ENTRY

KEY IN V21E
AND LOAD
CORRECT DATA

#180

#190

#200

#210

#220

#230

#240

#250

260

482

R03/SKYLARK

TRANSFER ENTIRE
VEHICLE WEIGHT TO
WEIGHT/G

TRANSFER CSM WEIGHT
TO WEIGHT/S

IS WHICH DAP SET?
(IS DOCKED DAP
RUNNING)

.N .Y

COMPUTE AND
TRANSFER
DATA TO RCS
DAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY GIMBAL ACTU-
ATOR TRIM VALUES:

V06 N48
R1-PITCH TRIM
R2-YAW TRIM
R3-BLANK

HOLD
.....
SNAP

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF GIMBAL ACTUATOR
TRIM VALUES

#270

#280

#290

#300

#310

PITCH TRIM AND YAW
TRIM-SPS ENGINE BELL
TRIM ANGLES AT
IGNITION DATA
TAKEN IN DEGREES
TO NEAREST .01
DEGREE.

#320

DO THESE VALUES
AGREE WITH MY CARRY
ON DATA?

Y. .N

WAIT FOR KEYBOARD
ENTRY

#330

KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

P. .NEW
R. .DATA
O. .
C. .
E. .
D. .

#340

LOAD DESIRED
DATA

EXIT R03

#350

EXIT
R03

CHANGE CONTROL NOTES

REV 00 PCR 040

.....
OBS
LASH
RESPON
F DAP
ATA

PLE CON-
TROL
1-USE Z
FORCE
CONTROL

#80

E - YAW CONTROL
0-USE TOR-
QUE COU-
PLE CON-
TROL
1-USE Y
FORCE
CONTROL

#90

R2: CHANNEL 5 JET
INHIBIT

TO INHIBIT JETS,
SELECT CORRE-
SPONDING OCTAL
VALUES FROM
FOLLOWING TABLE
AND LOAD THEIR
SUM (CDE) IN R2.

#100

JET	BIT #	VALUE
-----	-------	-------

C3(1)	1	00001
C4(4)	2	00002
A3(3)	3	00004
A4(2)	4	00010
D3(5)	5	00020
D4(8)	6	00040
B3(7)	7	00100
B4(6)	8	00200

#110

R3: CHANNEL 6 JET
INHIBIT

TO INHIBIT JETS,
SELECT CORRE-
SPONDING OCTAL

#120

VALUES FROM
FOLLOWING TABLE
AND LOAD THEIR
SUM (CODE) IN R3.

CH6 FAIL
OCTAL

JET BIT # VALUE

B1(9) 1 00001
B2(12) 2 00002
D1(11) 3 00004
D2(10) 4 00010
A1(13) 5 00020
A2(16) 6 00040
C1(15) 7 00100
C2(14) 8 00200

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P .NEW
.R .DATA
.D .
.C .
.E .
.E STORE
.D DATA

LOAD DESIRED
DATA

#130

#140

#150

#160

#170

RESET 500**FLG AND
501**FLG;

HOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE AND
SNAP . DISPLAY DAP RATE AND
DEADBAND

V06 N89
R1 - DAP RATE
R2 - DAP DEADBAND
R3 - BLANK

R1-DOCKED DAP RATE
IN DEG/SEC TO
NEAREST .0001
DEG/SEC
R2-DOCKED DAP DEAD-
BAND IN DEGREES
TO THE NEAREST
.01 DEG.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

```

.P
.R
.NEW
.DATA

```

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF DAP RATE AND
DEADBAND

AM I SATISFIED WITH
THIS DAP DATA?

2
Y

KEY IN
PROCEED

LOAD DESIRED	DATA
100	100
200	200
300	300
400	400
500	500
600	600
700	700
800	800
900	900
1000	1000

081

#190

#200

210

.....EXI

EXIT R04

[illegible]

EXIT R04

STORE
DATA

CHANGE CONTROL NOTES

REV 00 PCR 040,454

1 490

R04/SIKYLARK

550
RJ4/SKYLARK

#220

#230

TERMINATE FLASH UPON
RECEIPT OF PROCEED
RECYCLE OR TERMINATE

•V34E •P •ENTER

 α

•

۱۰۰

•

INTRODUCTION

3. **USE OF THE**

```

      L280          • RESET
      -----      • AUTOSEQ
                  • FLAG

```

DO ROU-
TINE
ROO

EXIT R07

WAS P20 STARTED
WITH HEADS
ORIENTATION
SPECIFIED
(AZIMFLAG SET)?

2.

•YES.

SET AZIMFLAG

#30

第40

\$50

#60

70

493

555
R07/SKYLARK

IS HEADS UP DESIRED
(HDSUPFLG SET)?

• YES • NO

SET OMICRON=0
DEGREES
(R3 OF N78)

SET OMICRON=180
DEGREES
(R3 OF N78)

IS W-MATRIX VALID
FOR RENDEZVOUS
NAVIGATION
(RENDFLG SET)?

• NO • YES

SET FLAGS FOR
AUTO W-MATRIX
REINITIALIZA-
TION (MANEUFGL,
PTV93FLG)

RESET PCFLAG

#80

#90

#100

#110

#120

#130

R07/SKYLARK

START MINKEY
(SET AUTOSEQ
FLAG)

#140

#150

#160

#170

P32 INITIATION
POINT FROM R00

HOLD .
.....
SNAP .

FLASH VERB-NOUN
TO REQUEST PLEASE
PERFORM MINKEY
SEQUENCE:

V50 N25
R1-00017
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE VERB--NOUN
FLASH TO REQUEST
PLEASE PERFORM
MINKEY SEQUENCE

DO I WISH TO PERFORM
THE RENDEZVOUS USING
THE MINKEY SEQUENCE?

• NO

• YES

```

-----
WAIT FOR KEYBOARD      . . . . . KEY IN ENTER
ENTRY                  . . . . .
-----

```

TERMINATE FLASH UPON
RECEIPT OF ENTER,
PROCEED OR TERMINATE

V34E .P .E

 α

10

3.

RESET .E .R

• E •

LAG .D .

1

•

•

•

•

•

•

•

•

•

•

ROUT - RESET

INE • AUTOSEC

•

2

10

RO7/SKYLARK

#230

#240

#250

#260

#270

R00

FLAG

EXIT R07

WAS P20 STARTED
WITH HEADS
ORIENTATION
SPECIFIED
(AZIMFLAG SET)?

•NO •YES

SET AZIMFLAG

IS HEADS UP DESIRED
(HDSUPFLG SET)?

•YES •NO

SET OMICRON=0
DEGREES
(R3 OF N78)

SET OMICRON=180
DEGREES

(R3 OF N78)

#280

IS W-MATRIX VALID
FOR RENDEZVOUS
NAVIGATION
(RENDWFLG SET)?

#290

NO YES

SET FLAGS FOR
AUTO W-MATRIX
REINITIALIZA-
TION (MANEUFLG,
PTV93FLG)

#300

RESET PCFLAG

#310

START MINKEY
(SET AUTOSEQ
FLAG)

#320

CALL NC2 TARGETING
PROGRAM (P32)

IS THE MAGNITUDE OF
DELTA V (RSS OF N81)
GREATER THAN OR
EQUAL TO 10 FPS?

• YES **• NO**

CALL SPS
THRUSTING
PROGRAM
(P40)

CALL RCS
THRUSTING
PROGRAM
(P41)

GO TO
NCC INITIA-
TION POINT
IN THIS
ROUTINE
"D" BELOW

#380

#390

#410

#420

501

02478

084番

064番

\$500

#510

RO7 / SKYLARK

#520

#530

#540

#550

#560

START MINKEY
(SET AUTOSEQ
FLAG)

"D"

CALL THE NCC TARGET-
ING PROGRAM (P33)

IS THE MAGNITUDE OF
DELTA V (RSS OF N81)
GREATER THAN OR
EQUAL TO 10 FPS?

• YES • NO

CALL THE SPS
THRUSTING
PROGRAM
(P40)

CALL THE RCS
THRUSTING

PROGRAM
(P41)

GO TO THE NSR
INITIALIZATION
POINT IN THIS
ROUTINE
"E" BELOW

.P34
.NSR TARGET-
.ING INITI-
.ALIZATION
.POINT FROM
.R00

HOLD .
.....
SNAP .
.....
FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM MINKEY SEQUENCE
V50 N25
R1-00017
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM
MINKEY SEQUENCE

DO I WISH TO PERFORM
THE RENDEZVOUS USING
THE MINKEY SEQUENCE?

..NO ..YES

#570

#580

#590

#600

#610

KEY IN ENTER

KEY IN PROCEED

E N T E R

ET
DSEQ

DO YOU-
TINE
ROO

EXIT R07

WAS P20 STARTED
WITH HEADS
ORIENTATION
SPECIFIED
(AZIMFLAG SET)?

NO

YES

SET AZIMFLAG

IS HEADS UP DESIRED
(HDSUPFLG SET)?

• YES • NO

SET OMICRON=0
DEGREES
(R3 OF N78)

SET OMICRON=180
DEGREES
(R3 OF N78)

IS W-MATRIX VALID
FOR RENDEZVOUS
NAVIGATION
(RENDFLG SET)?

• NO • YES

SET FLAGS FOR
AUTO W-MATRIX
REINITIALIZA-
TION (MANEJFLG,
PTV93FL3)

RESET PCFLAG

#670

#680

#690

#700

#710

#720

#730

0428

#750

#760

506

ROT/SKYLARK

PROGRAM
(P41)

#770

#780

GO TO THE TPI
TARGETING
INITIALIZATION
POINT IN THIS
ROUTINE
"F" BELOW

#790

.P35
.TPI TARGET-
.ING INITIA-
.LIZATION
.POINT FROM
.R00

#800

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM MINKEY SEQUENCE
V50 V25
R1-00017
R2-BLANK
R3-BLANK

HOLD
SNAP

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM
MINKEY SEQUENCE

#810

DO I WISH TO PERFORM
THE RENDEZVOUS USING

THE MINKEY SEQUENCE?

•NO
•YES

#820

KEY IN ENTER

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF ENTER,
PROCEED OR TERMINATE

•V34E
•P
•E
•R
•N
•O
•T
•C
•E
•R
RESET
AUTOSEQ
FLAG

•E
•E
•D
RESET
AUTOSEQ
FLAG

#830

#840

DO ROU-
TIME
R00

#850

EXIT R07

WAS P20 STARTED
WITH HEADS
ORIENTATION
SPECIFIED
(AZIMFLAG SET)?

#860

•NO
•YES

509

571
ROT/SKYLARK

SET AZIMFLAG

#870

IS HEADS UP DESIRED
(HDSUPFLG SET)?

.YES .NO

SET OMICRON=0
DEGREES
(R3 OF N78)

#880

SET OMICRON=180
DEGREES
(R3 OF N78)

#890

IS W-MATRIX VALID
FOR RENDEZVOUS
NAVIGATION
(RENDWFLG SET)?

.NO .YES

SET FLAGS FOR
AUTO W-MATRIX

#910

ROT/SKYLARK

REINITIALIZA-
TION (MANEUF LG,
PTV93FLG)

RESET PCFLAG

START MINKEY
(SET AUTOSEQ
FLAG)

CALL THE TPI TARGET-
ING PROGRAM (P35)

IS THE MAGNITUDE OF
DELTA V (RSS OF N81)
GREATER THAN OR
EQUAL TO 10 FPS?

.YES .NO
.
.
.
.
.
.
.
.
.
.

#920

#930

#940

#950

#960

R1-00017
R2-BLANK
R3-BLANK

MINKEY SEQUENCE

.
.
.
.

DO I WISH TO PERFORM
THE RENDEZVOUS USING
THE MINKEY SEQUENCE?

.NO .YES

KEY IN ENTER

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF ENTER,
PROCEED OR TERMINATE

KEY IN PROCEED

V34E .P .E
.R .N
. . .T
.C .E
RESET .E .R
AUTOSEQ .E
FLAG .D RESET
AUTOSEQ
FLAG

DO ROU-
TINE
R00

EXIT R07

#1020

#1030

#1040

#1050

#1060

#1070

#1080

#1090

#1100

#1110

WAS P20 STARTED
WITH HEADS
ORIENTATION
SPECIFIED
(AZIMFLAG SET)?

•NO •YES
•
•
•
•
•
•

SET AZIMFLAG

IS HEADS UP DESIRED
(HDSUPLG SET)?

•YES •NO
•
•

SET OMICRON=0
DEGREES
(R3 OF N78)

SET OMICRON=180
DEGREES
(R3 OF N78)

IS W-MATRIX VALID
FOR RENDEZVOUS

NAVIGATION (RENDWFLG SET)?	.NO	.YES

SET FLAG FOR
AUTO W-MATRIX
REINITIALIZA-
TION (MANEJFLG,
PTV93FLG)

RESET PCFLAG

START MINKEY
(SET AUTOSEQ
FLAG)

CALL THE TPM TARGETING PROGRAM

• • • • •

```

(P36) -----
      .
      .
      .
      -----
      IS THE MAGNITUDE OF
      DELTA V (RSS OF N81)
      GREATER THAN OR
      EQUAL TO 10 FPS?
      -----
      .YES      .NO
      .
      .
      .
      .
      -----
      CALL THE SPS
      THRUSTING
      PROGRAM
      (P40)
      -----
      .
      .
      .
      .
      -----
      CALL THE RCS
      THRUSTING
      PROGRAM
      (P41)
      -----
      .
      .
      .
      .
      .
      .
      .
      .
      .
      .
      -----
      CALL THE TPM
      TARGETING
      PROGRAM (P36)
      -----
      .
      .
      .
      -----
      IS THE MAGNITUDE OF
      DELTA V (RSS OF N81)
  
```

#1160

#1170

#1180

#1190

#1200

#1210

#1220

#1230

#1240

#1250

GREATER THAN OR
EQUAL TO 10 FPS?

YES NO

CALL THE SPS
THRUSTING
PROGRAM
(P40)

CALL THE RCS
THRUSTING
PROGRAM
(P41)

GO TO
RENDEZVOUS
FINAL PHASE
PROGRAM INITIAL-
IALIZATION
POINT IN THIS
ROUTINE
"H" BELOW

P37 RENDEZVOUS
FINAL PHASE
INITIALIZATION
POINT FROM R00

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM MINKEY SEQUENCE
V50 N25

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM

HOLD
SNAP

R1 - 00017
R2 - BLANK
R3 - BLANK

MINKEY SEQUENCE

#1260

DO I WISH TO PERFORM
THE RENDEZVOUS USING
THE MINKEY SEQUENCE?

.NO .YES

#1270

WAIT FOR KEYBOARD
ENTRY

KEY IN ENTER

TERMINATE FLASH UPON
RECEIPT OF ENTER,
PROCEED OR TERMINATE

KEY IN PROCEED

#1280

.V34E .P .E
.R .N
.O .T
.C .E
RESET .E .R
AUTOSEQ .E
FLAG .D

RESET
AUTOSEQ
FLAG

#1290

DO RUU-
TIME
R00

#1300

EXIT R07

GO TO
"H"
BELOW

#1310

WAS P20 STARTED WITH
HEADS ORIENTATION
SPECIFIED (AZIMFLAG
SET)?

•NO •YES
•
•

SET AZIMFLAG

#1320

IS HEADS UP DE-
SIRE (HDSUPLG
SET)?

#1330

•YES •NO
•
•

SET
OMICRON=0
DEGREES
(R3 OF N78)

#1340

SET
OMICRON=180
DEGREES
(R3 OF N78)

#1350

IS W-MATRIX VALID FOR
RENDEZVOUS NAVIGATION

R07/SKYLARK

CALL RENDEZVOUS
THRUST MONITOR
PROGRAM (P48)

PERFORM ROUTINE 00
(R00)

EXIT R07

P38
.PLANE CHANGE
.INITIATION
.POINT FROM
.R00

HOLD .
.....
SNAP .
FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM MINKEY SEQUENCE
V50 N25
R1-00017
R2-BLANK
R3-BLANK

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM
MINKEY SEQUENCE

DO I WISH TO PERFORM
THE RENDEZVOUS USING
THE MINKEY SEQUENCE?

.NO .YES

#1410

#1420

#1430

#1440

520

#1450

WAIT FOR KEYBOARD ENTRY
..... KEY IN ENTER

TERMINATE FLASH UPON
RECEIPT OF ENTER,
PROCEED OR TERMINATE
..... KEY IN PROCEED

#1460

.V34E .P .E
 .R .N
 .O .T
 .C .E
RESET .E .R
AUTOSEQ .E .
FLAG .D .

RESET
AUTOSEQ
FLAG

#1470

DO ROUTINE
R00

#1480

EXIT R07

WAS P20 STARTED
WITH HEADS
ORIENTATION
SPECIFIED
(AZIMFLAG SET)?

.NO .YES

#1490

SET AZIMFLAG

#1500

IS HEADS UP DESIRED
(HDSUPFLG SET)?

• YES • NO
•
•

#1510

SET OMICRON=0
DEGREES
(R3 OF N78)

SET OMICRON=180
DEGREES
(R3 OF N78)

#1520

IS W-MATRIX VALID
FOR RENDEZVOUS
NAVIGATION
(RENDFLG SET)?

• NO • YES
•
•

#1530

SET FLAS3 FOR
AUTO W-MATRIX
REINITIALIZA-
TION (MANEUF LG,
PIV93FLG)

#1540

RESET PCFLAG

#1550

523

585
R07/SKYLARK

START MINKEY
(SET AUTOSEQ
FLAG)

#1560

CALL PLANE CHANGE
TARGETING PROGRAM
(P38)

#1570

IS MAGNITUDE OF
DELTA V (RSS OF N81)
EQUAL TO ZERO?

#1580

YES NO

#1590

PERFORM R03

DO THE IMU
REALIGNMENT
PROGRAM
(P52)

#1600

R07/SKYLARK

CALL
THE RCS
THRUSTING
PROGRAM
(P41)

#1660

#1670

SET PCMANFLG

CALL THE UNIVERSAL
TRACKING PROGRAM
(P20)

#1680

RESET PCMANFLG

#1690

CALL THE INU REALIG-
NMENT PROGRAM (P52)

PERFORM ROUTINE R00

#1700

EXIT R07

CHANGE CONTROL NOTES

REV 00 PCR 011,021, PCN 411,435, SL MEMO #2

526

ROT/SKYLARK

588
ROT/SKYLARK

VHF RANGE READ ROUTINE (R08)

REV 00 05/19/71

PURPOSE:

(1) TO READ RANGE FROM VHF DATA LINK AND RECORD TIME OF THE READING.

ASSUMPTIONS: (1) THE VHF IS ON.

(2) THIS ROUTINE IS SELECTED BY R22 FOR VHF NAVIGATION MEASUREMENTS WHEN ENABLED BY V87E (DISABLED BY V88E).
 THIS ROUTINE IS SELECTED BY R22 VIA R27 FOR RANGE RATE FILTER MEASUREMENT WHEN ENABLED BY V76E (DISABLED BY V77E).

THIS ROUTINE IS SELECTED BY P25 AND P48 VIA R27 FOR RANGE RATE FILTER MEASUREMENT.

(3) WHEN CALLED BY R22, THE VHF MEASURED RANGE IS EXTENDED BEYOND 327.67 N.M. IF INDICATED BY THE RANGE COMPUTED IN R61 USING THE ON-BOARD STATE VECTOR ESTIMATES.

PROG
CONT

CREW

GROUND

CMC

•CMC ROUTINE
 •SELECTION

•
 •
 •
 •
 •

 START VHF RANGE READ
 ROUTINE (R08)

•
 •
 •

 RESET BITS 1-4 OF
 CHANNEL 13

•
 •
 •

 SYNCHRONIZE SETTING
 OF RADAR ACTIVITY

#10

#20

030

• • •

040

...

...

050

...

093

R A D A R D A T . . .

0270

Y.

N.

593
R08 / SKYLARK

EXIT
R08

STORE RAW RADAR
DATA FOR
DOWNLINK

06#

IS DATA GOOD SIGNAL
PRESENT
(CHANNEL 33 BIT2)?

2.

OCT 1964

**TURN ON
TRACKER FAIL
LIGHT**

TURN OFF
TRACKER FAIL
LIGHT

0110

IS RAW RADAR
DATA = J?

#120

EXIT R08

ROB / SKYLARK

#130

TO CALLER'S
ERROR RETURN

CONVERT RAW DATA
FROM N.M. TO METERS

#140

IS EXCHANGE SET?
(IS THERE A STATE
VECTOR RANGE ESTI-
MATE FROM R61
AVAILABLE?)

Y. .N

#150

IS DIFFERENCE
BETWEEN R61
COMPUTED RANGE
AND VHF RANGE
GREATER THAN
300 N.M.?

Y. .N

ADD 327.68
N.M. TO VHF
RANGE

#170

EXIT R08
TO CALLER'S
GOOD RETURN

531

595
R08/SKYLARK

CHANGE CONTROL NOTES

REV 00 PCR 032, SL MEMO #19

2

R08/SKYLARK

REFERENCEZVOUS TRACKING SIGHTING MARK ROUTINE (R21)

REF 00 05/19/71

PURPOSE:

(1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE UNIVERSAL TRACKING PROGRAM (P20), OPTIONS 0,4.

ASSUMPTIONS: (1) SIGHTINGS ARE MADE ON THE QWS USING THE SXT.

(2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES 5 ANGLES (3 I'DUS AND 2 O'DUS) AND THE TIME OF MARK IN POSITION #1. IF A MARK IS REJECTED (BY PRESSING MARK REJECT BUTTON) THE MARK DATA IN POSITION #1 IS ERASED IF ANY. OTHERWISE A FLAG IS SET FOR R22 REJECTION BEFORE INCOMP.

THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN POSITION #1 ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #1, IT IS MOVED TO POSITION #2 FOR PROCESSING BY (R22). IF NO DATA IS IN POSITION #1, R22 INTERROGATES POSITION #1 AFTER 4 SECONDS.

IF MARKS ARE MADE AT A GREATER FREQUENCY THAN R22 PROCESSES THEM THE OVERFLOW FROM POSITION #1 IS LOST.
R22 INTERRUPTS POSITION #1 AFTER 4 SECONDS.

(13) THE TRACKING ATTITUDE ROUTINE (R61) WILL AUTOMATICALLY HOLD RENDEZVOUS REFERENCE VECTOR AIMED AT THE OWS, IF THE SSC CONTROL SWITCH IS PLACED AT CMG, IF THE AUTOMODE IS SELECTED AND IF THE PREFERRED ATTITUDE IS SPECIFIED IN N78. IF THE FREE MODE IS SELECTED THE ASTRONAUT MAY HOLD THE OWS IN THE FIELD OF VIEW USING THE MINIMUM IMPULSE CONTROLLER OR ROTATIONAL HAND CONTROLLER. IF THE ATTITUDE HOLD MODE IS SELECTED THE ASTRONAUT MAY HOLD THE OWS IN THE FIELD OF VIEW USING THE ROTATIONAL HAND CONTROLLER.

(4) THIS ROUTINE IS AUTOMATICALLY SELECTED BY A SXT MARK OR MARK REJECT DURING P20, OPTIONS 0,4.

PROG
CONT

CMC

GROUND

CREW

START RENDEZVOUS
TRACKING SIGHTING
MARK ROUTINE (R21)

SELECT MANUAL OPTICS
MODE

• • •

WAIT FOR MARK, MARK
REJECT

MARK

WHEN OWS IS AT
CENTER OF RETIC
PRESS MARK BUT

10

Preceding page blank

#20

WAS SIGHTING SATIS-
FACTORY?

.N .Y
. .
. .

. MARK REJECT.
.....
.

PRESS MARK
REJECT BUTTON
WITHIN 7 SEC
AFTER MARK

TERMINATE WAIT UPON
RECEIPT OF MARK,
MARK REJECT

.M
.A
.R
.K
.R
.E
.J
.E
.C
.T
. .

EXIT R21

ERASE
MARK DATA
IN POSI-
TION #1
(IF ANY)
OR SET
REJECTFLG
TO REJECT
MARK BE-
ING PRO-
CESSED BY
R22 (IF
ANY).

.

537 601

REV 01 03/20/72

RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22)

PURPOSE:

- (1) TO PROCESS RENDEZVOUS SIGHTING MARK DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR OWS AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).
- (2) TO PROCESS RENDEZVOUS VHF RANGING DATA TO UPDATE THE STATE VECTOR OF EITHER THE CSM OR OWS AS DEFINED BY THE STATE VECTOR FLAG (SEE P20).
- (3) TO CALL R27 WHEN ENABLED BY V76E.

ASSUMPTIONS:

- (1) THIS ROUTINE IS AUTOMATICALLY SELECTED BY THE UNIVERSAL TRACKING PROGRAM (P20), OPTIONS 0.4.
- (2) V06N49 DISPLAYED IN THIS ROUTINE IS A PRIORITY DISPLAY AND WILL REMAIN UP A MINIMUM OF 2 SECONDS. RESPONSE AFTER 2 SECONDS WILL CAUSE THE PROGRAM TO CONTINUE AS DESCRIBED.
- (3) V87E ENABLES VHF UPDATES. V37E XXE AND V88E INHIBIT VHF UPDATES.
- (4) THERE IS A RENDEZVOUS OPTICS MARK COUNTER AND A VHF RANGING MARK COUNTER IN THE CMC TO COUNT THE NUMBER OF MARKS INCORPORATED INTO EITHER STATE VECTOR. THESE COUNTERS CAN BE ZEROED BY THE FOLLOWING:
 - (A) W-MATRIX REINITIALIZATION
 - (B) KEYING V36E (FRESH START)
- (5) W-MATRIX INITIALIZATION FOR RENDEZVOUS MAY BE ENABLED IN ANY OF THE FOLLOWING WAYS:
 - (A) KEY V93E
 - (B) KEYING V36E
 - (C) STATE VECTOR UPDATE FROM THE GROUND.
 - (D) DURING MINKEY BY AUTOMATIC W-MATRIX INITIALIZATION LOGIC (SEE SECTION 5 OF THIS DOCUMENT).
- (6) THE TIME OF THE LAST W-MATRIX INITIALIZATION IS AVAILABLE BY KEYING V06 N31E.
- (7) IN R22 V76E ENABLES R27 AND V77E INHIBITS R27.

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PROG
CONT

CMC GROUND CREW

.CMC
.ROUTINE
.SELECTION

START RENDEZVOUS
TRACKING DATA PROC-
ESSING ROUTINE (R22)

SET VHF TIME TO
PRESENT TIME

BB 73

WAIT 4 SECONDS

IS RENDEZVOUS FLAG SET?

Y.
N.
EX11
R22

IS REFSMAT FLAG
SET?

#60

028

080

060

\$100

R22/SKYLARK

POSITION #2	.	.	.
SET R22CAFLG	.	.	.
CLEAR PJSSION #1	.	.	.
SET SOURCE CODE TO 1	.	.	.
"CM"	.	.	.
IS AUTOSCED FLAG SET?	.	.	.
EXERCISE AUTOMATIC W MATRIX REINITIALIZATION LOGIC (SEE SEC 5 OF THIS DOCUMENT).	.	.	.

R22/SKYLARK

#200

BASED ON THE DATA
AND ITS SOURCE
(OPTICS OR VHF AND,
IF OPTICS-PRIMARY OR
BACK UP)
CALCULATE THE RE-
QUIRED CORRECTION
TO UPDATE THE STATE
VECTOR DESIGNATED BY
THE STATE VECTOR
FLAG (SEE P20).
FOR DESCRIPTION
OF UPDATE PROCESS
REFER TO SECTION
5.2 OF R693

#210

#220

#230

#240

#250

#260

012

#280

06290

R22/SKYLARK

DELTA V-MAGNITUDE
OF THE DIFFERENCE
BETWEEN THE VELOCITY
VECTOR BEFORE AND
AFTER INCORPORATION
OF THIS MARK DATA.
IN FPS TO THE NEAR-
EST .1 FPS.

SOURCE CODE-DEFINES
SOURCE OF DATA:
1 = OPTICS MARKS
2 = VHF RANGING

WAIT 2 SECONDS

WAIT FOR KEYBOARD
ENTRY

IS THE SOURCE CODE
IN R3 = 1?

VERIFY THAT
MARKING WAS DONE
ON THE UMS AND
DISCUSS OUT OF
TOLERANCE CON-
DITION WITH THE
GROUND, IF
POSSIBLE.

VERIFY (TO BE
DEFINED) AND
DISCUSS OUT OF
TOLERANCE CON-
DITION WITH THE
GROUND, IF
POSSIBLE.

SHALL I INCORPORATE
THIS UPDATE?

KEY
V34E

KEY IN RE-
CYCLE V32E

0140

• • •

Y. **Z.**

03430

0440

#450

546

R22/SKYLARK

#510

#520

#530

#540

#550

548

R22/SKYLARK

"D"
ABOVE

#610

CALL VHF RANGE READ
ROUTINE (R08)

++
+01
++
++
+489
++

#620

IS THIS CALLER'S
ERROR RETURN?

.N .Y

#630

IS UPDATE FLAG
SET?

.Y .N

IS R60
OPERATING?

N. Y.

#640

STORE TIME OF
MARK IN VHFTIME

#650

GO TO

551

615
R22/SKYLARK

"B"
ABOVE

SET SOURCE CODE TO 2

#660

STORE TIME OF MARK
IN VHFTIME

#670

GO TO
"C"
ABOVE

CHANGE CONTROL NOTES

REV 00 PCR 016,017,018,025,032,439, PCN 442, SKYLARK MEMO #19
REV 01 PCN 489

R22/SKYLARK

553 617

RENDEZVOUS BACKUP SIGHTING MARK ROUTINE (R23) REV 01 03/20/72

PURPOSE: (1) TO PERFORM SIGHTING MARKS IN CONJUNCTION WITH THE UNIVERSAL TRACKING PROGRAM (P20) OPTIONS 0-4, BY USE OF A BACKUP OPTICAL DEVICE.

ASSUMPTIONS: (1) THE ASTRONAUT KNOWS THE COORDINATES (OPTICS) OF THE ALTERNATE LJS HE MUST USE FOR THIS ROUTINE

(2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES THE 3 ICDU'S, THE CONTENTS OF NOUN 94 AND THE TIME OF MARK IN POSITION #1. IF A MARK IS REJECTED BY KEYING IN V86E THE MARK DATA IN POSITION #1 IS ERASED OR A FLAG IS SET TO REJECT THE MARK IF R22 IS PROCESSING A MARK.

THE RENDEZVOUS TRACKING DATA PROCESSING ROUTINE (R22) ATTEMPTS TO PROCESS THE MARK DATA (IF ANY) IN POSITION #1 ONCE EVERY 4 SECONDS. IF DATA IS IN POSITION #1, IT IS MOVED TO POSITION #2 FOR PROCESSING BY (R22). IF NO DATA IS IN POSITION #1, R22 INTERROGATES POSITION #1 AFTER 4 SECONDS.

(3) THIS ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY KEYING IN V54E.

PROG
CONT

CMC	GROUND	CREW
		.CREW
		.ROUTINE
		.SELECTION
		...

START RENDEZVOUS BACKUP SIGHTING MARK ROUTINE (R23) KEY IN V54E
---	-------------------

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

N.	Y.
.	.
.	.
.	.
TURN ON OPERATOR	
ERROR LIGHT	

.....

#10

#20

R23/SKYLARK

Preceding page blank

ALARM

RESET R21MARK FLAG

INVALIDATE MARK
BUFFER

HOLD
SNAP

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY ALTERNATE
LOS COORDINATES

V06 N94
R1 SHAFT
R2 TRUNNION
R3 BLANK

SHAFT-OPTICS SHAFT
ANGLE IN DEGREES TO
NEAREST .01 DEGREES
TRUNNION-OPTICS
TRUNNION ANGLE IN
DEGREES TO NEAREST
.001 DEGREES

WAIT FOR KEYBOARD
ENTRY:

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
NEW OCDU ANGLES.

NOTE: THE VALUE OF
THESE REGISTERS
SHOULD CORRESPOND TO
THE CHOSEN ALTERNATE
LOS.

(THE NOMINAL ANGLES
TO BE USED FOR COAS
SIGHTINGS ARE:
R1-00000
R2-57470)

ARE THE DISPLAYED
ANGLES CORRECT FOR
THE CHOSEN LOS?

.Y .N

#80

#90

#100

#110

#120

#130

KEY IN V24E
AND LOAD
ANGLES.

#140

KEY IN
PROCEED

TERMINATE FLASH
UPON RECEIPT OF NEW
DATA OR PROCEED

NEW
DATA
PROCEED

#150

STORE
NEW DATA

#160

FLASH VERB-NOUN TO
REQUEST PLEASE PER-
FORM ALTERNATE LOS
SIGHTING MARK AND
DISPLAY MARK CTRS,
TFI, AND MGA:
V53N45
R1-MARK CTRS
R2-TFI
R3-MGA

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM AL-
TERNATE LOS SIGHTING
MARK, AND DISPLAY OF
MARK CTRS, TFI,
AND MGA.

#170

MARK CTR- THE NUM-
BER OF MARKS PROCES-
SED BY THE RENDEZ-
VOUS TRACKING DATA
PROCESSING ROUTINE
(R22) SINCE LAST
W-MATRIX REIN-
ITIALIZATION (REFER
TO ASSUMPTION (8)
OF P20). THE REGIS-
TER WILL DISPLAY
XXBX WHERE THE TWO
MOST SIGNIFICANT
DIGITS ARE THE VHF
RANGING MARK COUNTER
AND THE TWO LEAST
SIGNIFICANT DIGITS
ARE THE OPTICS MARK
COUNTER.

NOTE: THE OPTICS
MARK COUNTER DOES
NOT DISTINGUISH
BETWEEN BACKUP AND
PRIMARY MARKS.

TFL- TIME FROM TIG.
IN MIN AND SEC
TO NEAREST SEC.
MAXIMUM READING IS
59859. (-BEFORE, +
AFTER TIG)

MGA- MIDDLE GIMBAL
ANGLE AT TIG IF +X
CSM AXIS IS ALIGNED
WITH INITIAL THRUST
DIRECTION.
SIGN IS ALWAYS +
EXCEPT:

(A) WHEN DISPLAY-
ED AT ANY TIME
OTHER THAN THE
LAST PASS THROUGH
P31-P36, P38, THE
VALUE IS -00001

#180

#190

#200

#210

TERMINATE FLASH
UPON RECEIPT
OF ENTER, V86F
OR PROCEED

PROCEED

.V .P
.8 .N
.6 .T
.E .D
.R .C
.E .E
.D .D

ERASE
MARK DATA
IN POSI-
TION #1
(IF ANY)
OR SET
REJECTFLG
TO REJECT
MARK BE-
ING PRO-
CESSED BY
R22 (IF
ANY)

DO I WISH TO
MAKE MORE MARKS?

.Y .N

KEY IN PROCEED

EXIT
R23

#280

#290

#300

#310

#320

#330

0468

#350

R23/SKYLARK

560

CHANGE CONTROL VOTES

REV 00 PCR 011, PCN 457, SKYLARK MEND #2
REV 01 PCN 489

EXIT
R23

VHF RANGE RATE MARK PROCESSING ROUTINE (R27)

REV 01 03/20/72

PURPOSE:

(1) TO PROCESS VHF RANGING DATA TO UPDATE THE CURRENT RANGE STATE VECTOR (RANGE,RANGE RATE).

(2) TO PROCESS VHF RANGING DATA TO OBTAIN AN OPTIMUM ESTIMATE OF THE RANGE STATE VECTOR (RANGE,RANGE RATE) FOR A TIME TO SPECIFIED IN NOUN 72.

(3) TO CALCULATE THE RENDEZVOUS PARAMETERS PHI OR THETA, DEPENDING ON THE CALLING PROGRAM.

(4) TO INCREMENT OPTIMIZATION BY 4 MIN.

ASSUMPTIONS: (1) THIS ROUTINE IS AUTOMATICALLY SELECTED BY EITHER P25 OR P48.

(2) THIS ROUTINE IS SELECTED BY R22 PROVIDED THE ASTRONAUT HAS SET R27FLAG BY KEYING V76E AND KEYING PRO ON THE FLASHING V06N72 DISPLAY. R27 WILL CONTINUE WITHIN R22 UNTIL R27FLAG IS RESET BY KEYING V77E OR BY START OF P20 (SEE P20 INITIALIZATION LOGIC).

(3) THE RANGE RATE FILTER WILL BE REINITIALIZED BY THE PERFORMANCE OF ANY V37EXXE OR BY KEYING V76E AND P20.

(4) RANGE AND RANGE RATE ARE CALCULATED ON THE BASIS OF VHF RANGING DATA ONLY AND DO NOT REQUIRE EITHER VALID STATE VECTORS OR, EXCEPT FOR P48, THAT THE ISS BE ON.

(5) THE CALCULATION OF THE RENDEZVOUS PARAMETERS PHI (COMPUTED FOR R22) AND THETA (FOR P48) REQUIRES BOTH VALID STATE VECTORS AND THAT THE ISS BE ON AND ALIGNED TO A "KNOWN" ORIENTATION. IN THE CASE OF PHI, THE JSS MUST BE ON AND OPERATIONAL AND INTEGRATION MUST NOT BE IN PROGRESS.

(6) THE RANGE RATE FILTER REQUIRES APPROXIMATELY 190 SEC TO CONVERGE TO THE DESIRED ACCURACY.

(7) IF THE ASTRONAUT LOADS N72 WITH A TIME IN THE FUTURE, OPTIMIZATIONS WILL OCCUR AUTOMATICALLY EVERY 4 MINUTES, BEGINNING WITH THAT TIME (N72) SELECTED BY THE ASTRONAUT.

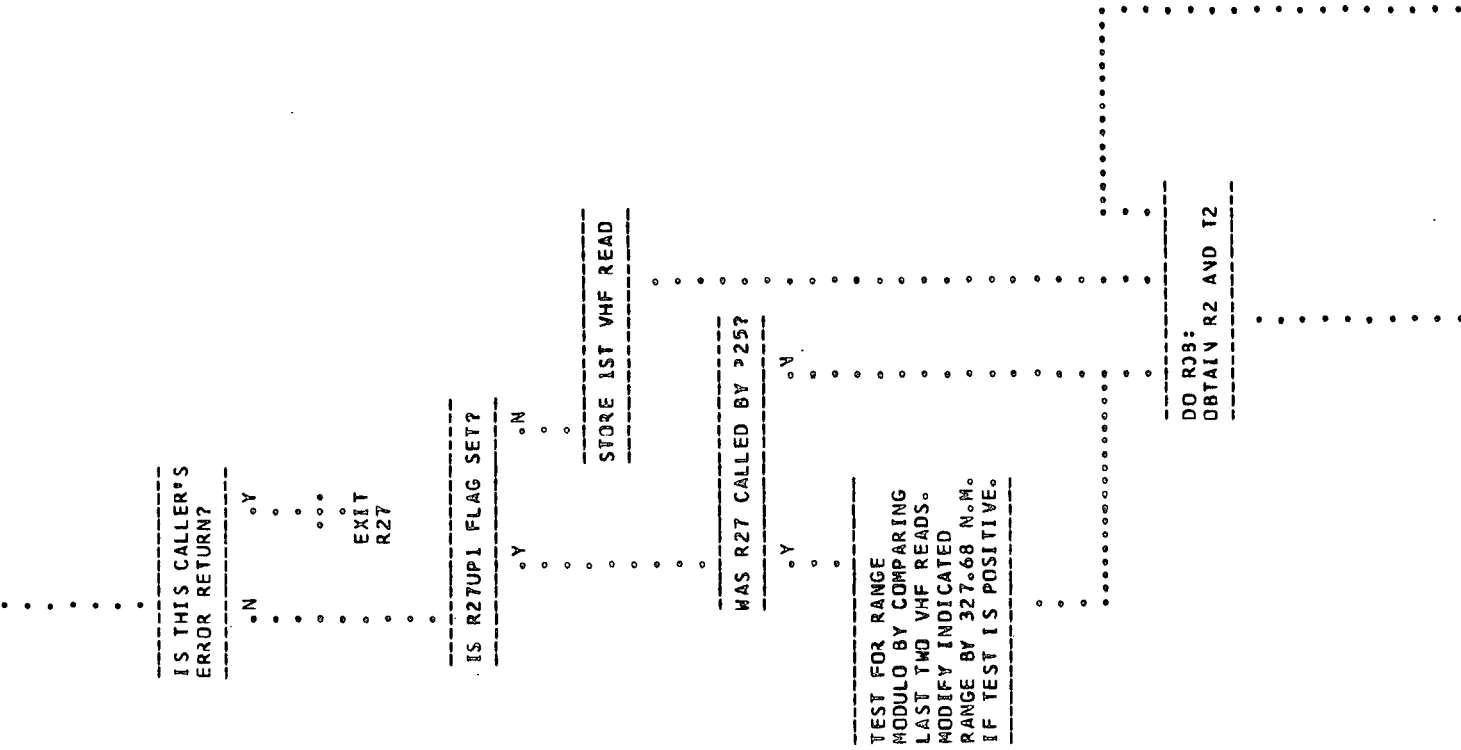
PROG
CONT

CMC GROUND CREW

.CMC
.ROUTINE
.SELECTION.
.
...
.-----
DO R08:
OBTAIN R1 AND T1

#10

R27/SKYLARK



#20

#30

#40

#50

#60

R27/SKYLARK

\$62

IS R27UP2 FLAG SET?

.Y .N
.
.

IS R27JP1 FLAG SET?

.Y .N
.
.

STORE 1ST MARK

.
.
.

SET R27UP1 FLAG

.
.
.

EXIT R27

INITIALIZE R27
(SEE SEC. 5)

.
.
.

RESET FIXFLAG

.
.
.

SET R27UP2 FLAG

.
.
.

#120

#130

#140

#150

#160

595

631
R27/SKYLARK

#170

#180

#190

#200

0124

R27/SKYLARK

SNAP CDU'S AND
COMPTJE PHI
FOR TD

101 459

STORE FINAL	.	OBSERVE OPTIMIZED
OPTIMIZED	.	VALUES OF RANGE,
R, R DOT	RANGE RFO IN N77
(RANGE, RATE)	.	BEFORE RFO = +01B35.
INTO N77.	.	NOTE: OPTIMIZED
	.	VALUES ARE REPLACED
	.	BY CURRENT VALUES
	.	AFTER RFO = +01B35.

#270

#280

#290

\$300

++
+01
+
+459
++

WAS R27 CALLED BY P25?

 γ
 z

IS TDFLAG SET?

Y.
Z.

**IS SNAPFLAG
SET?**

γ.
z.

WAS R27 CALLED BY
P48?

$$\gamma \cdot z$$

IS INTEGRATION IN PROGRESS?

$$z, y$$

SNAP CDJ'S AND
COMPUTE PHI FOR

THE CURRENT TIME

894 + +

COMPUTE THETA
FOR THE CURRENT
TIME

IS FIXFLAG SET?

IS THE PRE-
SENT TIME
GREATER THAN
THE TIME CO
TAINED IN
N72?

```

.Y
.
.
-----
SET TOFLAG

```

21 A 10

PRECEDING PAGE BLANK NOT FILMED

ORBITAL PARAMETERS DISPLAY ROUTINE (R30)

REV 01 03/20/72

PURPOSE:

(1) TO PROVIDE THE ASTRONAUT PERTINENT ORBITAL PARAMETERS COMPUTED BY THE CMC TO SUPPLEMENT ORBITAL INFORMATION PROVIDED HIM BY THE GROUND.

ASSUMPTIONS:

(1) THE COMPUTATIONS MADE DURING THIS ROUTINE ARE UPDATED ABOUT EVERY TWO SECONDS ONLY IF THE AVERAGE 3 ROUTINE IS ON WHEN THIS ROUTINE IS CALLED.

(2) THE VALUE OF TFF OR TPER WILL BE MADE TO COUNT DOWN IF THE AVERAGE 6 ROUTINE IS NOT ON WHEN THIS ROUTINE IS CALLED.

(3) IF AVERAGE 6 ROUTINE IS OFF, THE ASTRONAUT MAY KEY IN THE PREDICTED GET TIME OF PERIGEE IN ORDER TO CAUSE THE CMC TO DO PRECISION INTEGRATION TO THAT TIME AND THEN MAKE A CONIC CALCULATION.

(4) IF TFF IS NOT COMPUTABLE BECAUSE TRAJECTORY DOES NOT INTERSECT THE INTERFACE ALTITUDE (E.G. ON THE PAD), THE CMC WILL SET TFF EQUAL TO -59859. ALSO, IF PER ALT IS GREATER THAN THE INTERFACE ALTITUDE OF 300,000 FT CMC WILL COMPUTE TPER; OTHERWISE TPER=0. TPER IS STORED IN N32 AND THE ASTRONAUT MAY CALL IT BY KEYING IN N32E.
TPER: TIME FROM NOW TO PERIGEE ALTITUDE IN HRS, MIN, AND SEC. FOR SIGN CONVENTION, SEE ASSUMPTION 5.

(5) SIGN CONVENTION FOR TFF AND TPER: DSKY DISPLAY IS NEGATIVE (DECREASING) AS INTERFACE ALTITUDE IS APPROACHED. BETWEEN INTERFACE ALTITUDE AND PERIGEE ALTITUDE, DISPLAY IS POSITIVE (INCREASING). WHEN PERIGEE IS PASSED, R30 CONTINUES TO DISPLAY POSITIVE INCREASING TIME EXCEPT DURING AVERAGE-3 OR ON V32 RESPONSE TO V16N44. NEGATIVE (DECREASING) TIME WILL BE DISPLAYED FOR ELLIPSES IN THESE CASES.

(6) IF THIS ROUTINE IS CALLED WHILE THE EARTH ORBIT INSERTION MONITOR PROGRAM (P11) IS ON OR WHEN IN CMC IDLING PROGRAM (P00), THE CMC WILL DISPLAY SPLERROR IN N50 BY KEYING IN N50E. IF THE APOGEE IS ABOVE 300,000 FT ALTITUDE AND THE PERIGEE IS BELOW 300,000 FT ALTITUDE ABOVE THE LAUNCH PAD, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PREDICTED AND THE DESIRED ABORT TARGET. IF THESE CONDITIONS ARE NOT SATISFIED, SPLERROR WILL BE DISPLAYED AS THE DISTANCE BETWEEN THE PRESENT POSITION VECTOR AND THE DESIRED ABORT TARGET.

(7) REFER TO THE NOUN LIST IN THE BACK OF THIS DOCUMENT FOR DEFINITION OF THE CONTENTS OF NOUNS 32 AND 50.

(8) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW

.CREW
.ROUTINE
.SELECTION
. . .
. . .

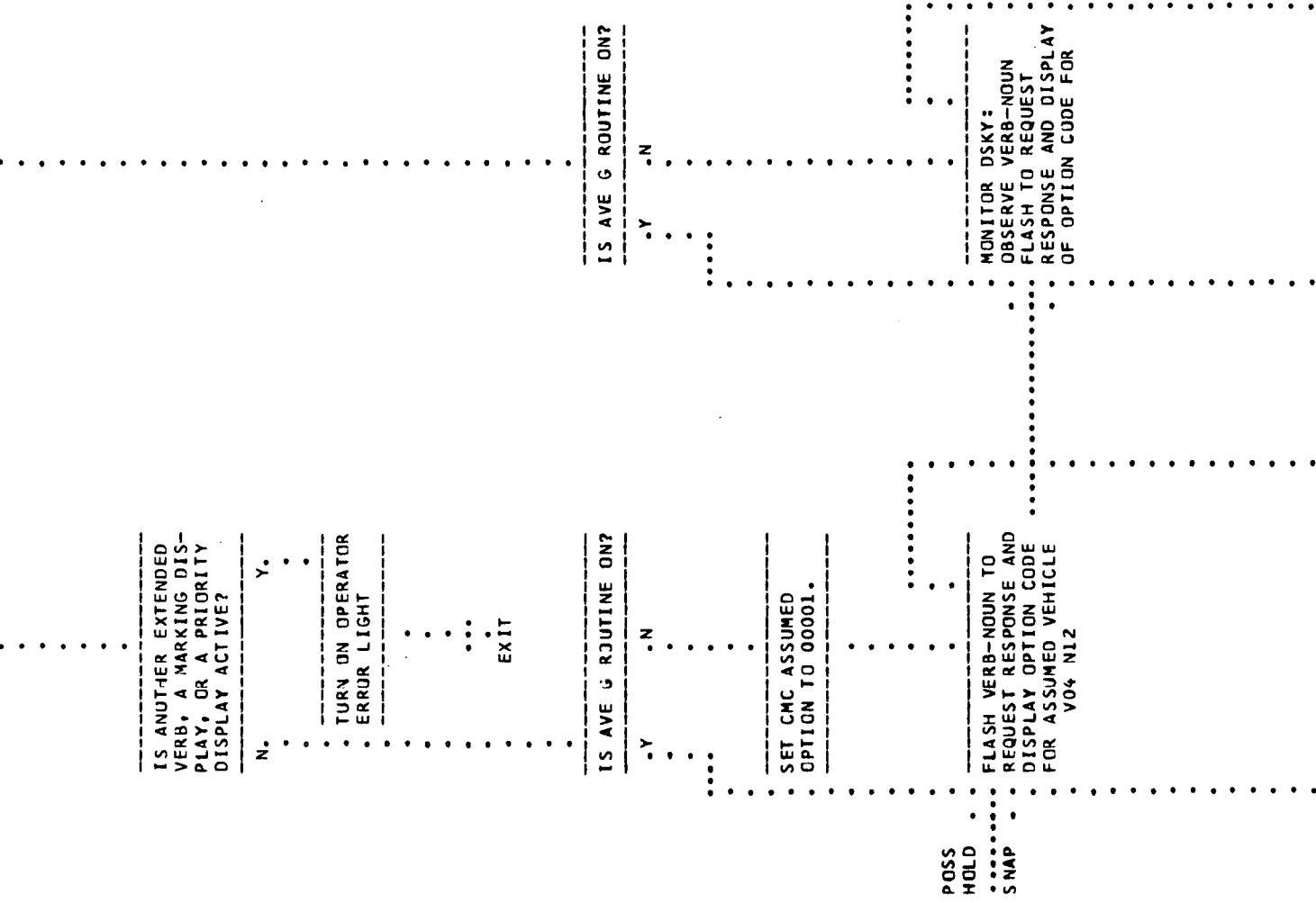
START ORBITAL PARA-
METERS DISPLAY
ROUTINE (R30)

KEY IN V82E

#10

R30/SKYLARK

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#20

#30

#40

#50

#60

R1-00002
R2-0000X
R3-BLANK

R1 IS THE OPTION
CODE FOR ASSUMED
VEHICLE.

R2 IS THE CMC ASSUM-
ED OPTION:
00001-THIS VEHICLE
00002-OTHER VEHICLE

ASSUMED VEHICLE (OWS
OR CSM)

#70

#80

IS THE VEHICLE
(OWS OR CSM) AS-
SUMPTION CORRECT?

.Y .N

WAIT FOR KEYBOARD
ENTRY

#90

KEY IN PRO-
CEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

.P .NEW
.R .CODE
.D .DATA
.C .
.E .
.E .
.D .
STORE CODE
DATA

#100

KEY IN
V22E
AND LOAD
THE
DESIRED
VEHICLE
(OWS OR
CSM)
CODE IN-
TO R2.

#110

#120

#130

#140

#150

#160

#170

SET NOUN 16 EQUAL
TC 00000

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY TIME OF
EVENT.

V06 N16
R1-T(IEVENT)-HRS
R2-T(IEVENT)-MIN
R3-T(IEVENT)-SECS
T(IEVENT)-TIME TO
WHICH STATE VECTOR
WILL BE INTEGRATED
TO NEAREST 0-01 SEC.
(ZER0ES INDICATE
PRESENT TIME WILL
BE USED)

WAIT FOR KEYBOARD
ENTRY

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
TIME OF EVENT.

DO I WISH TO HAVE
THE CMC COMPUTE
PARAMETERS FOR THE
PRESENT TIME?

AM I SATISFIED
WITH THE DIS-
PLAYED TIME?

ARE ALL
THREE RE-
GISTERS
EQUAL TO
ZERO?

KEY IN
PROCEED

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR NEW
DATA

```

      .PROCEED
      .NEW
      .DATA
      .

```

STORE NEW
DATA

IS NOUN 16
ZERO?

YES. NO.

SET TDECL
TO PRE--
SENT TIME

SET YDECI
TO TIME IN
NOUN 16

EXTRAPOLATE SELECTED
VEHICLE STATE VECTOR
TO TIME IN TDEC1

KEY IN V25E AND LOAD
NEW DATA.

#180

#190

#200

#210

USING PRECISION
EQUATIONS

#220

COMPUTE APD ALT, PER
ALT, AND TFF. (SEE
ASSUMPTION 4.)

#230

IS PER ALT GREATER
THAN 300,000 FT?

#240

SET TPER COMPUTE
EQUAL TO TPER.
ZERO.

#250

IS AVE G ROUTINE ON?

#260

IS THE CUR- IS THE
RENT PRJ- CURRENT
GRAM P11? PROGRAM
P00?

.N .Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

HOLD .
.....
MON .

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY ORBIT PARA-
METERS:

VI6 N44

R1-APJ ALT

R2-PER ALT

R3-TFF

APD ALT-ALTITUDE

OF APOGEE ABOVE

THE LAUNCH PAD

RADIUS. IN NAUTI-

CAL MILES TO NEAR-

EST .1 NM.

PER ALT-ALTITUDE

OF PERIGEE ABOVE

THE LAUNCH PAD

RADIUS. IN NAUTI-

CAL MILES TO NEAR-

EST .1 NM.

MONITOR DSKY:

OBSERVE VERB-NOUN

FLASH TO REQUEST

RESPONSE AND DIS-

PLAY OF APO

ALT, PER ALT

AND TFF

IS AVERAGE G ROUTINE

ON?

.N .Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

.N

.Y

DO I WISH TO

HAVE THE CAL-

TFF-TIME OF FREE
FALL FROM NOW TO
AN INTERFACE AL-
TITUDE OF 300,000
FT. FOR SIGN CON-
VENTION, SEE
ASSUMPTION 5.
ALTITUDE DEFINED
ABOVE THE LAUNCH
PAD RADIUS.
IN MIN, SEC TO
NEAREST SEC. MAX
READING IS -59859.
NOTE: WHEN THE
TRAJECTORY DOES
NOT INTERSECT THE
INTERFACE ALT-
ITUDE (E.G. ON
THE PAD), THE TFF
DISPLAY WILL READ
-59859.
NOTE: IF PER ALT OR
APO ALT EXCEEDS
SCALE THE DISPLAY
WILL BE 9999.9 NM.

WAIT FOR KEYBOARD
ENTRY

CULATIONS RE-
PEATED? (SEE
ASSUMPTION 1)

.Y .N

KEY IN
RECYCLE
V32E
NOTE:
THE
KEYING
OF RE-
CYCLE
DURING
AVE G
WILL
HAVE NO
EFFECT.

++
+01
++
++
++
++
++
++
++489
++

#320

#330

#340

#350

#360

.
. .
. .
. .
. .
. .
. .

NOTE:
REFER TO ASSUMP-
TIONS FOR DEFINI-
TION OF ADDITIONAL
DISPLAYS AVAILABLE
IN THIS ROUTINE.
WHEN FINISHED WITH
THIS ROUTINE
KEY IN PROCEED

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

.P .R
.R .E
.O .C
.C .Y
.E .C
.E .L
.D .E
. .
. .
....
EXIT
R30

#370

#380

. .
. .
. .
. .
. .
. .
....
EXIT
R30

CHANGE CONTROL NOTES

REV 00 PCN 410
REV 01 PCN 489

REV 01 03/20/72

RENDEZVOUS PARAMETER DISPLAY NO 1 ROUTINE (R31)

PURPOSE:

(1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS PARAMETERS (RANGE, RANGE RATE, THETA)

ASSUMPTIONS:

(1) RANGE AND RANGE RATE ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED OWS AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON. THE ISS MUST BE ON AND ALIGNED TO A "KNOWN" ORIENTATION IF A CORRECT DISPLAY OF THETA IS DESIRED. THE RANGE/RANGE RATE/THETA DISPLAY IS NOT INHIBITED HOWEVER IF THE IMU IS NOT ON AND ALIGNED.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY USKY ENTRY OR AUTOMATICALLY SELECTED BY P37.

PROG
CONT

CMC GROUND CREW

CMC
ROUTINE
SELECTION
.
.
.
...

CREW
ROUTINE
SELECTION
.
.
.
...

START
RENDEZVOUS PARAMETER
DISPLAY NO 1 ROUTINE
(R31)

KEY IN V83E

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

.N .Y

TURN ON OPERA-
TOR ERROR LIGHT

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PRECEDING PAGE BLANK NOT FILMED

#10

#20

#30

#40

#50

#60

#70

#80

584

R31/SKYLARK

EXIT

IS AVERAGE G RUN-
NING?

N Y

SFT T = PRESENT
TIME

EXTRAPOLATE OWS
AND CSM STATE
VECTORS TO T
USING COASTING
INTEGRATION
ROUTINE

SET T = AVERAGE
G TIME.

++
+01
+489
++

V16 N54
R1-RANGE
R2-RANGE RATE
R3-THETA
RANGE-CALCULATED
RANGE TO DWS. IN
NAUTICAL MILES TO
NEAREST .01 NM.
RANGE RATE--
CALCULATED RANGE
RATE BETWEEN CSM AND
DWS. NEGATIVE SIGN
INDICATES CLOSING
IN FPS TO NEAREST
.1 FPS
THETA-ANGLE BETWEEN
CSM +X AXIS AND THE
LOCAL HORIZONTAL
PLANE AT THE PRESENT
TIME. FROM 0 TO 360
DEGREES. IN DEGREES
TO NEAREST .01
DEGREE
IS AVERAGE G
RUNNING?
N Y
SET TF = AVERAGE
G TIME

OF RENDEZVOUS
PARAMETERS.
(NOTE: THESE PARA-
METERS WILL BE
UPDATED ABOUT EVERY
TWO SECONDS.)

#140

#150

#160

#170

586

[illegible]

#230

CHANGE CONTROL NOTFS

REV 00 PCR 007,011, PCN 410, SKYLARK MEMO #2
REV 01 PCN 489

654
R3L/SKYLARK

385

R31/SKYLARK

RENDEZVOUS PARAMETER DISPLAY NO 2 ROUTINE (R34) REV 01 03/20/72

PURPOSE:

(1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS PARAMETERS (RANGE, RANGE RATE, PHI)

ASSUMPTIONS:

(1) RANGE AND RANGE RATE ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED OWS AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON. THE ISS MUST BE ON AND ALIGNED TO A "KNOWN" ORIENTATION AND THE OPTICAL SUBSYSTEM MUST BE ON AND OPERATIONAL, IF A CORRECT DISPLAY OF PHI IS DESIRED. THE RANGE/RANGE RATE/PHI DISPLAY IS NOT INHIBITED HOWEVER IF THE IMU IS NOT ON AND ALIGNED OR THE OPTICS IS OFF.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW
ROUTINE
SELECTION

START
RENDEZVOUS PARAMETER
DISPLAY NO 2 ROUTINE
(R34)

KEY IN V85E

#10

#20

#30

IS ANOTHER EXTENDED
VERB, A MARKING DIS-

EXTRAPOLATE OWS
AND CSM STATE
VECTORS TO T
USING COASTING
INTEGRATION
ROUTINE.

SET T=AVERAGE G
TIME.

EXTRAPOLATE OWS
STATE VECTOR TO
T USING COASTING
INTEGRATION
ROUTINE.

SET TF =
PRESENT
TIME

EXTRAPOLATE OWS AND
CSM STATE VECTORS
TO TF FROM T USING
KEPLER SUBROUTINE

#90

\$100

#110

#120

DEI #

0170

CALCULATE RANGE,
RANGE RATE AND
PHI

MONITOR DSKY:
OBSERVE VERB=NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF RENDEZVOUS
PARAMETERS.
(NOTE: THESE PARA-
METERS WILL BE
UPDATED ABOUT EVERY
TWO SECONDS.)

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY RENDEZVOUS
PARAMETERS:

V16 N53
R1-RANGE
R2-RANGE RATE
R3-PHI

RANGE-CALCULATED
RANGE TO OWS. IN
NAUTICAL MILES TO
NEAREST .01 NM.

RANGE RATE-
CALCULATED RANGE
RATE BETWEEN CSM AND
TOWS. NEGATIVE SIGN
INDICATES CLOSING
IN FPS TO NEAREST
0.1 FPS
OPTICS-ANGLE BETWEEN
OPTICS STAR LINE OF
SIGHT AND THE LOCAL
HORIZONTAL PLANE AT
THE PRESENT TIME.
ANGLE IS ALWAYS
POSITIVE.
FROM 0 TO 360

RENDEZVOUS OUT-OF-PLANE DISPLAY ROUTINE (R36)

REV 00 05/19/71

PURPOSE:

(1) TO DISPLAY AT ASTRONAUT REQUEST CMC CALCULATED RENDEZVOUS OUT-GO-->PLANE PARAMETERS (Y CM, Y DOT CM, Y DOT OMS).

ASSUMPTIONS:

(1) THESE PARAMETERS ARE CALCULATED BY THE CMC ON THE BASIS OF THE STORED OWS AND CSM STATE VECTORS AND DO NOT REQUIRE THAT THE ISS BE ON.

(2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PRDG	CONT
------	------

CMC

GRUND

CREW

- CREW
- ROUTINE
- SELECTION

START THE RENDEZVOUS
OUT-OF-PLANE DISPLAY
ROUTINE (R36)

KEY IN V90E

010

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

#20

Y.
Z.

TURN ON
OPERATOR
ERROR LIGHT

030

SET T(EVENT)
TO TIG.

HOLD	.	FLASH VERB NOUN TO
.	.	REQUEST RESPONSE AND
.	.	DISPLAY T(EVENT) IN
SNAPE	.	G.E.T.:
.	.	V06 V16
.	.	R1-T(EVENT)-HRS
.	.	R2-T(EVENT)-MINS
.	.	R3-T(EVENT)-SECS

MONITOR ODSKY:
OBSERVE VERB NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF TIME AT WHICH
OUT-OF-PLANE PARA-
METERS ARE DESIRED.

T(EVENT): TIME
(G.E.T.) FOR WHICH
OUT-OF-PLANE PARA-
METERS ARE DESIRED
IN HRS, MINS, AND
SECS TO NEAREST .01
SECONDS.

DO I WISH TO HAVE
THE CMC COMPUTE
PARAMETERS FOR THE
PRESENT TIME?

ALL ZEROES (LOADED
BY ASTRONAUT) INDI-
CATING PRESENT TIME

z.

597

667
R36/SKYLARK

#80

#90

#100

#110

#120

#130

R36/SKYLARK

AM I SATISFIED
WITH THE DIS-
PLAYED TIME?

.N .Y

ARE ALL
THREE
REGISTERS
EQUAL TO
ZERO?

.Y .N

KEY IN
PROCEED

KEY IN V25E AND LOAD
NEW DATA (ALL ZEROS
FOR PRESENT TIME).

WAIT FOR KEYBOARD
ENTRY:

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

.P
.R
.D
.C
.E
.E
.D

STORE NEW
DATA

IS T(EVENT) ZERO?

.N .Y

EXTRAPOLATE CSM
AND DMS VECTORS

TO THE PRESENT
TIME USING
PRECISION
INTEGRATION

EXTRAPOLATE CSM
AND OWS STATE
VECTORS TO THE
TIME DEFINED BY
T(EVENT) USING
PRECISION
INTEGRATION

CALCULATE OUT-OF-
PLANE PARAMETERS:
Y CM
Y DOT CM
Y DOT OWS

FLASH VERB NOUN TO
REQUEST RESPONSE AND
DISPLAY RENDEZVOUS
OUT-OF-PLANE PARA-
METERS:
V06 V96
R1 Y CM
R2 Y DOT CM
R3 Y DOT OWS

Y CM-(NOTE: FOR
DEFINITION OF
PARAMETERS REFER
TO SECTION
5.6 OF THIS
DOCUMENT.) IN
NAUTICAL MILES TO

HOLD
SNAP

MONITOR DSKY:
OBSERVE VERB NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF RENDEZVOUS OUT-
OF-PLANE PARAMETERS

DO I WISH TO RECEIVE
ANOTHER DATA POINT

#140

#150

#160

#170

THE NEAREST .01
NM.

Y DOT CM-RATE OF
CHANGE OF Y CM
(+ IS INCREASING
AND - IS DE-
CREASING) IN FPS
TO THE NEAREST
.1 FPS.

Y DOT OWS-RATE OF
CHANGE OF Y OWS
(+ IS INCREASING
AND - IS DE-
CREASING) IN FPS
TO THE NEAREST
.1 FPS.

WAIT FOR KEYBOARD
ENTRY:

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR RECYCLE

.R
.E
.C
.Y
.C
.L
.E
.P
.R
.O
.C
.E
.D
....
EXIT

FOR A DIFFERENT
TIME?

.N .Y

KEY IN RECYCLE
V32E

KEY IN PROCEED

....
EXIT
R36

#180

#190

#200

#210

#220

.
.
.
.
.
.
.
.
.....

R36

CHANGE CONTROL NOTES

REV 00 PCR 452, PCN 457

670
R36/SKYLARK

#230

600 R36/SKYLARK

REV 01 03/20/72

SPS THRUST FAIL ROUTINE (P40)

PURPOSE:

- (1) TO INDICATE TO THE ASTRONAUT THAT THE GNCS HAS DETECTED A THRUST FAILURE.
- (2) TO PROVIDE THE ASTRONAUT A FLASHING DISPLAY TO WHICH HE CAN RESPOND AS DESCRIBED IN THE FLOW.

ASSUMPTIONS: (1) THE GNCS HAS DETECTED A THRUST FAILURE AND HAS SHUT OFF CROSS PRODUCT STEERING AND HAS STOPPED C.G. TRACKING.

- (2) IF THE ASTRONAUT KEYS IN PROCEED ON THIS DISPLAY THRUST FAILURE DETECTION WILL BE INHIBITED FOR 2 SECONDS TO PREVENT A PREMATURE THRUST FAIL INDICATION.
- (3) THIS ROUTINE IS SELECTED BY THE SPS THRUSTING PROGRAM (P40)

PROG
CONT

CMC

GROUND

CREW

- .CMC
- .ROUTINE
- .SELECTION
- .
- .
- .
- .
- .

HOLD

MON

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY THRUSTING
PARAMETERS
V97N40
R1 XXBX
R2 VG
R3 DELTA VM

MONITOR DSKY:
OBSERVE VERB NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF THRUSTING
PARAMETERS.

SHALL I TERMINATE
THE ENGINE ON COMM-
AND AND RETURN TO
THE V99 FLASH WHICH
WILL ALLOW ME TO

#10

#20

30

○々々

050

160

028

602

R40/SKYLARK

603

675
R40/SKYLARK

#80

#90

#100

#110

#120

R40/SKYLARK

SET MAIN PAN-
EL DIRECT
THRUST SWITCH
TO ON

KEY IN
PROCEED

SHALL I TERMINATE
THE ENGINE ON COM-
MAND AND THE SPS
THRUSTING PROGRAM
(P40)?

KEY IN TERMINATE
V34E

TERMINATE FLASH UPON
RECEIPT OF PROCEED,
ENTER OR TERMINATE

.P .E .T
.R .N .E

#130

#140

#150

#160

604

R40/SKYLARK

.
T . R
E . M
R . I
N . N
A . A
T . T
E . E

.
O .
C .
E .
E .
D .

ENABLE
CG TRACK-
ING, AND
REDISPLAY
V06N40
(NON-
FLASHING)

COMMAND
R40 FOR 2
ENGINE
SECONDS OFF

INHIBIT
R40 FOR 2
SECONDS

WAIT
ABOUT
2.5 SEC

TURN OFF
TVC DAP
AND DIS-
ABLE TVC
INTER-
FACE

WAIT
ABOUT

605

677
R40/SKYLARK

170

0814

#190

#200

012

#220

R40/SXYLARK

#230

.
. .
. .
. .
. .
. .

TURN OFF
TVC DAP

. .
. .

SET NARROW
DEACBAND
IN RCS DAP

. .
. .

SET SBFLAG

++
+01
+
+
+489
++

#240

. .
. .

DRIVE SPS ENGINE
BELL TO TRIM PO-
SITION.
NOTE: THE TRIM
POSITION IS THAT
LAST DEFINED BY
THE C.G. TRACKING
COMPUTATION.

#250

. .
. .

TURN ON RCS
DAP IN .6
SEC

#260

. .
. .
...

GO TO
"A"

607

679
R40/SKYLARK

IN P40

#270

CHANGE CONTROL NOTES

REV 00 PCN 457
REV 01 PCN 489

D

R40/SKYLARK

REV 00 05/19/71

STATE VECTOR INTEGRATION (MID TO AVE) ROUTINE (R41)

- PURPOSE:
- (1) TO INTEGRATE THE STATE VECTOR OF THIS VEHICLE TO THE TIME AT WHICH THE AVERAGE 3 ROUTINE WILL BE TURNED ON BY THE CALLING PROGRAM.
 - (2) TO DEFINE A NEW TIG FOR PROGRAMS 40 OR 41 IN THE EVENT THE STATE VECTOR CAN NOT BE INTEGRATED TO THE TIME DEFINED BY PROGRAMS 40 OR 41 AND TO LIGHT THE ALARM LIGHT TO INFORM THE CREW THAT TIG HAS BEEN SLIPPED.
- ASSUMPTIONS:
- (1) THERE IS A SIGNIFICANT AMOUNT OF TIME REQUIRED BY THE CMC TO TURN ON THE AVERAGE 3 ROUTINE. THIS TIME IS APPROXIMATELY 2 SECONDS PER TIME STEP IN EARTH ORBIT WHERE TIME STEP IS EQUAL TO APPROXIMATELY 240 SECONDS.
 - (2) THE ROUTINE IS ONLY AUTOMATICALLY SELECTED.

PROG
CONT

CMC

GROUND

CREW

CMC ROUTINE
SELECTION

Preceding page blank

IS CALLING PROGRAM
P40 OR P41?

.Y .N

SET MIDIFLAG

RESET MIDIFLAG

PRECEDING PAGE BLANK NOT FILMED

#10

#20

#30

#40

#50

#60

#70

610 R41/SKYLARK

T-TO-ADD=
TIMEDEL =
12.5 SEC

READ PRESENT TIME,
TP

IS MIDIFLAG SET?

.Y .N

IS TDEC-TIMEDEL
GREATER THAN OR
EQUAL TO TP?

.Y .N

TURN ON PRO-
GRAM ALARM
LIGHT AND
STORE ALARM
CODE 1703

RESET
MIDIFLAG

MONITOR DSKY PROGRAM
ALARM LIGHT DURING
THE PERIOD FROM TIG
-42.46 SECONDS TO
BLANKING AT TIG-35:
IF LIGHT COMES ON
DURING THIS TIME IT
INDICATES THAT TIG
WILL BE SLIPPED AS
REQUIRED TO GET THE
STATE VECTOR INTEG-
RATED TO A NEW TIG
-30 SECONDS.
IF THIS ALARM
CONDITION OCCURS THE

TFI DISPLAY WILL CONTINUE TO COUNT BASED ON THE ORIGINAL TIG UNTIL INTERGRATION IS COMPLETE AND A NEW TIG IS ESTABLISHED. THE DISPLAY WILL NOT BLANK HOWEVER UNTIL THE NEW TIG HAS BEEN ESTABLISHED AND TFI IS REVISED.

060

OCT 1964

OBSERVE THAT THE
COMPUTER ACTIVITY
LIGHT GOES OFF WHICH
INDICATES THAT THIS
ROUTINE IS COMPLETE

0110

EXIT R41

#120

R41/SKYLARK

#130

0418

4150

0913

#170

612

R41/SKYLARK

CHANGE CONTROL VOTES

REV 00 PCN 410,457

COARSE ALIGN ROUTINE (R53) REV 00 05/19/71

PURPOSE: (1) TO COARSE ALIGN AND GYRO TRIM THE IMJ TO A DESIRED INERTIAL ORIENTATION.

ASSUMPTIONS: (1) THE DESIRED IMU INERTIAL ORIENTATION HAS BEEN SPECIFIED BY THE CALLING PROGRAM.

(2) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE IMU REALIGN PROGRAM (P52) AND BY THE BACKUP IMU REALIGN PROGRAM (P54).

PROG CONT	CMC	GROUND	CREW	
	.CMC .ROUTINE .SELECTION			#10
	START COARSE ALIGN ROUTINE (R50)			
	. . .			
	READ PRESENT IMU ORIENTATION W.R.T. THE VEHICLE. (GIMBAL ANGLES)			#20
	. . .			
	SELECT PRESENT IMU INERTIAL ORIENTATION FROM STORAGE			#30
	. . .			
	CALCULATE THE INERTIAL ORIENTA-			

• • •

078

SELECT DESIRED IMU
INERTIAL ORIENTATION
FROM STORAGE (PRO-
VIDED BY CALLING
PROGRAM).

...

050

**CALCULATE REQUIRED
FINAL GIMBAL ANGLES
TO GIVE DESIRED IMU
INERTIAL ORIENTATION**

09

IS ANY REQUIRED
GIMBAL ANGLE CHANGE
GREATER THAN 1
DEGREE?

#70

SWITCH ISS TO COARSE .
ALIGN MJDE. TERMINATE. .
ATTITUDE HOLD OF .
VEHICLE .

80

COARSE ALIGN THE IMU :

REV 00 05/19/71

AUTOMATIC OPTICS POSITIONING ROUTINE (R52)

PURPOSE:

- (1) TO POINT THE STAR LJS OF THE OPTICS AT A STAR DEFINED BY THE PROGRAM OR BY DSKY INPUT (ASTRONAUT).
- (2) TO POINT THE STAR LJS OF THE OPTICS AT THE OWS DURING RENDEZVOUS TRACKING OPERATIONS.
- (3) TO DO THE TRACKING ATTITUDE ROUTINE (R61) APPROXIMATELY EVERY 2 SECONDS DURING RENDEZVOUS TRACKING OPERATIONS.

ASSUMPTIONS:

- (1) THE ROUTINE IS AUTOMATICALLY SELECTED BY IMU REALIGN PROGRAM (P52) OR BY THE UNIVERSAL TRACKING PROGRAM (P23).
- (2) THIS ROUTINE IS SELF PERPETUATING AND IS TERMINATED BY THE SIGHTING MARK ROUTINE (P53) FOR STARS AND BY RESETTING THE TRACK FLAG FOR OWS.

PROG
CONT

CREW

GROUND

CMC

.CMC ROUTINE
.SELECTION

Preceding page blank

START AUTOMATIC
OPTICS POSITIONING
ROUTINE (R52)

RESET SIGHTING MARK
FLAG

#10

#20

PRECEDING PAGE BLANK NOT FILMED

IS THE TARGIFLG
SET?

THE LOGIC FROM THIS
POINT TO "B" BELOW
IS FOR THE OWS TAR-
GET CASE ONLY.

#30

YES NO

#40

RESET
TERM-
INATE
FLAG

#50

GO TO
"B"
BELOW

DO THE TRACKING
ATTITUDE ROUTINE
(R61).

#60

IS TRACK FLAG SET?
(SEE P20)

#70

Y N
EXIT

619

693
R52/SKYLARK

R52

IS UPDATE FLAG SET?

.N .Y

WAIT ABOUT 1.3
SECONDS

EXTRAPOLATE CSM AND
OWS STATE VECTORS TO
THE PRESENT TIME
+2.4 SECONDS USING
CONIC EQUATIONS

READ PRESENT VEHICLE
ATTITUDE FROM THE
ICDU'S

COMPUTE TARGET VEC-
TOR FROM CSM TO OWS

#80

#90

#100

#110

#120

R52/SKYLARK

CALCULATE THE REQUIRED OPTICS ANGLES
TO POINT THE STAR
LINE OF SIGHT AT
THE OWS.

#130

CHECK OPTICS MODE
DISCRETE. IS THE
OSS IN THE
CMC MODE?

#140

IS A TRUNNION
ANGLE GREATER
THAN APPROX 50
DEG. REQUIRED TO
POINT THE STAR
LINE OF SIGHT AT
THE OWS ?

#150

DRIVE DRIVE
SHAFT SHAFT
AND CDU
TRUNNION AND
CDU'S DRIVE
TRUN-
NION
TO

#160

#170

620

621

695
R52/SKYLARK

APPROX
50
DEG-
REES

WAIT 0.5 SEC

GO TO
"A"
ABOVE

28

THE LOGIC FROM
THIS POINT ON IS FOR

#180

#190

#200

#210

R52/SKYLARK

THE STAR TARGETS
ONLY

00 13 30

• • • • •

IS TERMINATE
FLAG SET?

```
N .....  
Y . . . . .  
. . . . .  
.. ..  
EXIT R52
```

EXIT R52

CHECK OPTICS. MODE
DISCRETE. IS THE
LOSS IN THE CMC
MODE?

CALL SIGHTING
MARK ROUTINE

622

R52/SKYLARK

#270

092#

#250

042

1230

220

697
R52/SKYLARK

(R53) IF NOT
ALREADY CALLED

WAIT .5 SEC

GO TO
PAGE
ABOVE

GET PRESENT IMU
ORIENTATION FROM
STORAGE (REFSMAT)

READ PRESENT VEHICLE ATTITUDE FROM ICDU'S

GET STAR DATA FROM
CMC STORAGE

COMPUTE TARGET VECTOR FROM CSM TO

0828

#290

\$300

#310

R52/SKYLARK

#320

#330

#340

#350

#360

R52/SKYLARK

624

DESIGNATED STAR.

CALCULATE THE RE-
QUIRED OPTICS ANGLES
TO POINT THE STAR
LOS OF THE OPTICS
ALONG THE TARGET
VECTOR.

IS A TRUNNION ANGLE
REQUIRED TO POINT
THE STAR LOS OF THE
OPTICS AT THE TARGET
GREATER THAN 90 DEG?

.N .Y

FLASH VERB-NOUN
TO REQUEST RESP-
ONSE AND DISPLAY
ALARM CODE:

V05N09
R1-
R2-
R3-

EXPECTED ALARM
CODE AT THIS
TIME IS 404

WAIT 2 SECONDS

PCSS
PRIO
HOLD
.....
SNAP

MONITOR DSKY:
DOES ALARM CODE
DISPLAY INDICATE
THAT THE TARGET IS
NOT WITHIN THE
HEMISPHERE OF
OPTICS VISIBILITY?

.Y N.

FOR STAR SIGHTINGS
THERE ARE TWO
OPTIONS:

(A) MANUALLY MA-
NEUVER VEHICLE
UNTIL OPTICS CAN
ACQUIRE THE DES-
IRED TARGET.

#370

(B) TERMINATION
OF THE PRO-
GRAM AND
ROUTINE.

.A .

.B .

. .

. .

MANUALLY
MANEUVER VEH-
ICLE UNTIL IT
IS ESTIMATED
THAT OPTICS
CAN ACQUIRE
THE TARGET.
MONITOR FDI
TO AVOID
GIMBAL LOCK.

#380

#390

WAIT FOR KEY-
BOARD ENTRY.

KEY IN
PROCEED

#400

TERMINATE FLASH
UPON RECEIPT OF
PROCEED, OR
TERMINATE.

KEY IN TERMIN-
ATE.

V34E

.P
.R
.O
.C
.E
.T
.E
.R
.M
.I

GO TO

#410

#420

#430

#440

#450

#460

"B"
ABOVE

WAIT .5 SEC

GO TO
"B"
ABOVE

DO ROUTINE
RJO

DO ROUTINE
ROO

EXIT R52
AND CALLING
PROGRAM

EXIT R52
AND CALLING
PROGRAM

IS SIGHTING
MARK FLAG SET?

.Y .N

DISPLAY ON DSKY:
VJ6N92
R1-SHAFT
R2-TRUNNION
R3-BLANK
SHAFT-DESIRED

MONITOR DSKY:
OBSERVE DISPLAY
OF DESIRED OPTICS
ANGLES. NOTE: THIS
DISPLAY WILL NOT
APPEAR IF R53 HAS
ALREADY BEEN CALLED

POSS
MON

BY SWITCHING OPTICS
MODE SWITCH TO
MANUAL.

SHAFT ANGLE. IN
DEGREES TO NEAR-
EST .01 DEGREE.

TRUNION-DESIRED
TRUNION ANGLE.
IN DEGREES TO
NEAREST .001
DEGREE.

CHECK OPTICS MODE
DISCRETE. IS THE
OSS IN CMC MODE?

z.

IS THE TRUN-
NION ANGLE
REQUIRED TO
POINT THE STAR
LOS OF THE
OPTICS AT THE
TARGET GREATER
THAN APPROX 50
DEGREES?

γ

DRIVE SHAFT AND TRUN- NION CDU'S -----	DRIVE SHAFT CDU AND DRIVE TRUN- NION -----
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
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88	88
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94	94
95	95
96	96
97	97
98	98
99	99
100	100

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•

#470

480

0649#

#500

SIGHTING MARK ROUTINE (R53)

REV 01 03/20/72

PURPOSE:

(1) TO PERFORM A SATISFACTORY NUMBER OF OPTICAL SIGHTING MARKS FOR THE REQUESTING PROGRAM (OR ROUTINE).

ASSUMPTIONS:

(1) SIGHTINGS ARE MADE WITH EITHER SCT, SXT, ATM SUN SENSOR OR ATM STAR TRACKER.

(2) WHEN THE CMC ACCEPTS A MARK IT RECORDS AND STORES 3 OCDU ANGLES, 2 OCDU ANGLES (FOR OPTICS MARKS), AND THE TIME OF THE MARK. IN ADDITION, IF THE MARK IS FOR THE ATM STAR TRACKER THE CREW WILL BE REQUESTED TO LOAD THE STAR TRACKER GIMBAL ANGLES (N14).

(3) THE ROUTINE REQUIRES THAT ONE MARK BE TAKEN FOR NORMAL TERMINATION. IF THE ASTRONAUT GETS INTO THIS ROUTINE AND ELECTS NOT TO MARK HE SHOULD KEY V34E OR CALL A NEW PROGRAM BY KEYING IN V37EXXE.

(4) THE ROTATION OR MINIMUM IMPULSE CONTROLLER MAY BE USED AS REQUIRED TO REDUCE THE S/C DRIFT RATE.

(5) IF THE MARK IS FOR THE ATM SUN SENSOR, THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY AND THE ATM MUST BE IN THE SOLAR INERTIAL ATTITUDE.

(6) IF THE MARK IS FOR THE ATM STAR TRACKER, THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY AND THE STAR TRACKER GIMBAL ANGLES LOADED IN N14 SHOULD BE THOSE RECORDED BY THE CREW AT THE TIME OF THE MARK.

(7) IN P50 THE ROUTINE IS SELECTED WHEN THE CREW SELECTS OPTION 1 OR 2 IN N06. FOR OPTION 1 A MARK IS MADE WHEN THE ATM IS IN THE SOLAR INERTIAL ATTITUDE. FOR OPTION 2 A MARK IS MADE WHEN THE ATM IS IN THE SOLAR INERTIAL ATTITUDE AND THE ATM STAR TRACKER IS TRACKING A STAR.

(8) THE ROUTINE IS AUTOMATICALLY SELECTED BY P51.

(9) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE IMU REALIGN PROGRAM (P52) WHEN THE CREW LOADS THE SOURCE CODE FOR ATM SUN SENSOR OR ATM STAR TRACKER IN N70.

(10) IN P55 THE ROUTINE IS SELECTED WHEN THE CREW SELECTS OPTION 2 IN N06.

(11) THE ROUTINE IS SELECTED IN THE AUTO OPTICS POSITIONING ROUTINE (R52) BY CREW SELECTION OF MANUAL OPTICS MODE OR SWITCHING OPTICS ZERO TO ZERO.

PROG
CONT

CMC

GROUND

CREW

.CMC ROUTINE
.SELECTION

START SIGHTING MARK
RCUTINE (R-53)

SET SIGHTING
MARK FLAG

$\pi A''$

FLASH VERB
TO REQUEST PLEASE
MARK:
V51 N BLANK
R1-BLANK
R2-BLANK
R3-BLANK

HOLD . . .

(NOTE: NOUN AND
R1 WILL NOT BE
BLANK IF ENTERED
FROM MARK REJ.
AFTER V50N25, R1
= 00016 DISPLAY)

A blank dot grid for plotting data. The vertical axis is labeled 'Y' at the bottom and 'N' at the top. The horizontal axis is labeled 'X' at the right. The grid consists of 10 columns and 10 rows of dots.

630

R53/SKYLARK

LIGHT AND
STORE
ALARM CODE
GO110

.
.
...
GO TO
"A"
ABOVE

RESET MARK FLAG

.
.
...
GO TO
"A"
ABOVE

SET MARK
FLAG

STORE FIVE ANGLES
AND TIME.

#110

#120

#130

#140

#150

632

#160

#170

#180

#190

MONITOR DSKY:
OBSERVE FLASHING
VERB-NOUN TO REQUEST
PLEASE PERFORM
TERMINATE MARK
SEQUENCE

WAS MARK
SATISFACTORY?

PRESS MARK
REJECT
BUTTON

GO TO
"A"

FLASH VERB NOUN TO
REQUEST PLEASE
PERFORM TERMINATE
MARK SEQUENCE:
V50 N25
R1-00016
R2-BLANK
R3-BLANK

WAIT FOR KEYBOARD
ENTRY.

HOLD
SNAP

#200

#210

#220

#230

#240

ABOVE

TERMINATE FLASH
UPON RECEIPT OF
PROCEED, OR MARK
REJECT

.MK .P
.REJ .R
.O
.C
.E
.E
.D

RESET MARK FLAG

IS P50.1FLG SET?

.N
.Y
.Y
.Y
.Y
.Y

SET TERMINATE
FLAG
(FOR USE
BY R52).

IS THIS P50 OPTION
1
(ATM SUN SENSOR)?

.N
.Y
.Y
.Y
.Y
EXIT R53

#250

#260

#270

#280

#290

R53/SKYLARK

• •

KEY IN V21E AND
LOAD DESIRED
CODE.

• •
• •
• •
• •

#320

#330

#340

R53 / SKYLARK

ATM SUN SEV-
SCR (C = 1)?

.N .Y

IS CELES-
TIAL BODY
CODE = SUN
(DE = 46)?

.Y .N

TURN ON OPERA-
TOR ERROR LIGHT

IS CALLING
PROGRAM P50?

.N .Y

IS SOURCE OF
SIGHTING
DATA ATM
STAR TRACKER
(C = 2)?

.N .Y

SET TER-
MINATE
FLAG (FJR
USE BY
R52).

IS THIS P50?

.N .Y

IS THIS ATM
STAR TRACKER
DATA?

.Y

EXIT
R53

#350

#360

#370

#380

#390

014

#420

#430

○ササキ

\$450

638

R53/SKYLARK

REV 00 05/19/71

SIGHTING DATA DISPLAY ROUTINE (R54)

PURPOSE:

(1) TO TEST THE ACCURACY OF A PAIR OF CELESTIAL BODY SIGHTINGS.

ASSUMPTIONS:

(1) THE ROUTINE IS NORMALLY AUTOMATICALLY SELECTED BY THE IMU ORIENTATION DETERMINATION PROGRAM (P51), BY THE IMU REALIGN PROGRAM (P52), BY THE BACKUP IMU ORIENTATION DETERMINATION PROGRAM (P53), OR BY THE BACKUP IMU REALIGN PROGRAM (P54).

PROG
CONT

CREW

GROUND

CMC

- CMC
- ROUTINE
- SELECTION
- ...

START SIGHTING DATA
DISPLAY ROUTINE
(R54).

#10

CALCULATE ANGLE BE-
TWEEN TWO CELESTIAL
BODIES USING STORED
EPHEMERIS DATA
(ACTUAL)

#20

CALCULATE ANGLE BE-
TWEEN TWO CELESTIAL
BODIES USING CELES-
TIAL BODY VECTORS
DERIVED FROM MARK
ANGLES (INDICATED)

#30

.....

PRECEDING PAGE BLANK NOT FILMED

Preceding page blank

EXIT "A"

080

GYRO TORQUING ROUTINE (R55)

REV 00 05/19/71

PURPOSE: (1) TO CALCULATE GYRO TORQUING ANGLES FOR FINAL (FINE) ALIGNMENT OF THE INERTIAL PLATFORM DURING AN INFLIGHT ALIGNMENT, TO DISPLAY THESE ANGLES AND TO TORQUE THE GYROS.

ASSUMPTIONS: (1) THE ROUTINE IS NORMALLY AUTOMATICALLY SELECTED BY THE IMU REALIGN PROGRAM (P52), OR BY THE BACKUP IMU REALIGN PROGRAM (P54).

PROG CONT	CMC	GROUND	CREW
--------------	-----	--------	------

- CMC
- ROUTINE
- SELECTION
- ...
- .

START GYRO TORQUING
ROUTINE (R55)

.

CALCULATE REQUIRED
TORQUING ANGLES FOR
EACH GYRO

.

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY

V06 N93
R1-DELTA GYRO X
R2-DELTA GYRO Y
R3-DELTA GYRO Z

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH AND DISPLAY OF
GYRO TORQUING ANGLES

.

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PRECEDING PAGE BLANK NOT FILMED

#10

#20

#30

• • • • •

WAIT FOR KEYBOARD
ENTRY

KEY IN
RECYCLE
V32E

EXIT R55

TERMINATE FLASH
UPON RECEIPT OF
PROCEED OR RECYCLE

RECUY

EXIT R55

SHALL I PERMIT
TORQUING? CONSIDER
MAGNITUDE OF TORQU-
ING ANGLES.

2.

KEY IN PROCEED

723
R55/SKYLARK

ယံ

PULSE RIGS THROUGH
DESIRED ANGLES

EXIT R55

CHANGE CONTROL VOTES

R55/SKYLARK

ALTERNATE LOS SIGHTING MARK ROUTINE (R56)

(1) TO PERFORM SIGHTING MARKS FOR THE BACKJP ALIGNMENT PROGRAMS (P53, P54).

(1) SIGHTINGS ARE MADE WITH EITHER (A) CSM ALTERNATE LINE OF SIGHT, (B) ATM SUN SENSOR, OR (C) ATM STAR TRACKER.

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(4) THE RHC IS USED TO POSITION THE SPACECRAFT SO THAT THE ALTERNATE LOS POINTS TOWARD THE CHOSEN CELESTIAL BODY.

(6) IF THE MARK IS FOR THE ATM STAR TRACKER, THE CSM MUST BE DOCKED TO THE ORBITAL ASSEMBLY, THE ORIENTATION OF THE ATM WITH RESPECT TO THE NAV BASE MUST BE KNOWN, AND THE STAR TRACKER GIMBAL ANGLES LOADED INTO NL4 SHOULD BE THOSE RECORDED BY THE CREW AT THE TIME OF THE MARK.

(8) ANY PROPORTIONAL SET OF COMPONENTS MAY BE LOADED IN N88. HOWEVER, UNIT VECTORS ARE RECOMMENDED.

R56/SKYLARK

• • • • •

STORE THREE ICDU
ANGLES AND THE TWO
OPTICS ANGLES OF
NOUN 94, AND THE
TIME OF THE MARK

FLASH VERB NOUN
TO REQUEST PLEASE
PERFORM TERMINATION
OF THIS ROUTINE

V50 V25
R1 00016
R2 BLANK
R3 BLANK

WAS THE SIGHTING SATISFACTORY?

z.

**WAIT FOR KEYBOARD
ENTRY**

KEY IN ENTER

TERMINATE FLASH UPON
RECEIPT OF ENTER OR
PROCEED

KEY IN PROCEED

6874

၁. ၁၁

၂. ၂၂

#170

#180

#190

002

#210

R56/SKY-LARK
130

00 - PLANET (ANY
PLANET)
01/45 - STAR (FROM
CELESTIAL BODY
CODE LIST)
46 - SUN
47 - EARTH

#220

WAIT FOR KEYBOARD
ENTRY

KEY IN
PROCEED

#230

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA.

KEY IN V21E AND
LOAD DESIRED
CODE.

#240

.P .NEW
.R .DATA
.O .
.C .
.E .
.E .
.D .
. .
. .
STORE

#250

IS THE CEL-
ESTIAL BODY DATA
CODE NEG-
ATIVE?

.N .Y
. .
. .

#260

IS THE
CELEST-

655

731
R56/SKYLARK

IAL BODY
CODE >47
{OCTAL}?

.N .Y

IS
SOUR-
CE
OF
SIGH-
TING
DATA
ATM
SUN
SFN-
SOR
(C=1)?

.N .Y

IS
CELE-
STIAL
BODY
CODE
= SUN
{DE =
46)?

.Y .N

TURN ON OPERATOR
ERROR LIGHT

#270

#280

#290

#300

#310

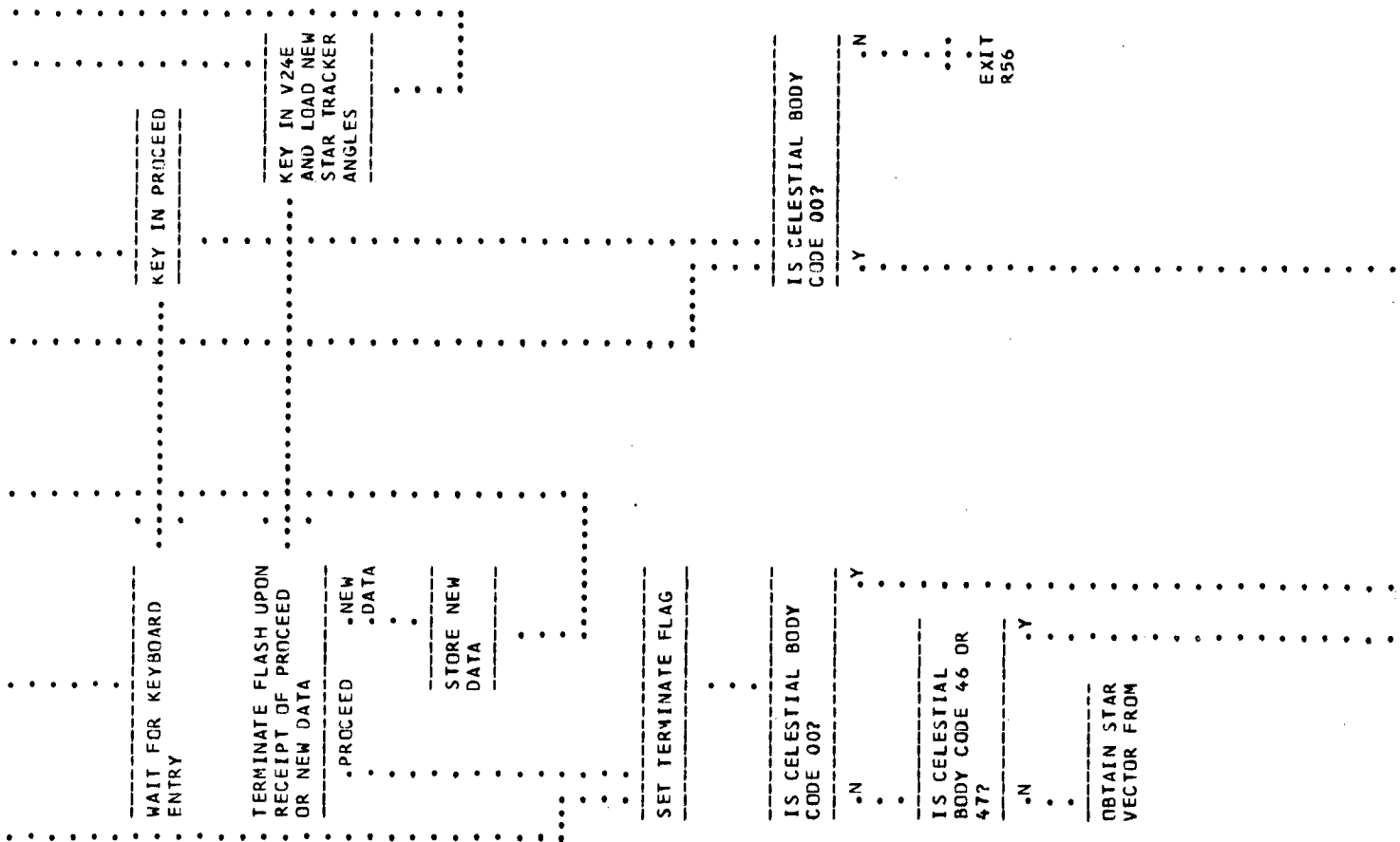
R56/SKYLARK

IS SOURCE OF SIGHT-
ING DATA ATM STAR
TRACKER (C = 2)?

$$\begin{array}{c} \gamma \\ \cdot \end{array} \quad \begin{array}{c} z \\ \cdot \end{array}$$

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY STAR TRACKER
GIMBAL ANGLES:
V06 NL4
R1-AZIMUTH (PSI)
R2-ELEVATION (PSI)
R3-BLANK

STAR TRACKER. IN ARC MINUTES TO THE NEAREST ARC MINUTE.



#370

#380

#390

#400

#410

STORED
EPHEMERIS

CALCULATE CEL-
ESTIAL BODY
VECTOR FOR THE
BODY DEFINED
BY THE STAR
CODE.

POSS
HOLD
.....
SNAP

FLASH VERB-
NOUN TO RE-
QUEST RESPONSE
AND DISPLAY
PLANET POSI-
TION VECTOR;
V06N88
R1-X PL
R2-Y PL
R3-Z PL
X PL - THE X
COMPONENT OF
UNIT POSITION
VECTOR OF THE
PLANET AT GET
IN REFERENCE
COORDINATES.
TO THE FIFTH
PLACE
(.XXXXX).
Y PL - SAME AS
X PL FOR Y
COMPONENT.

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF PLANET POSITION
VECTOR.

ARE THE POSITION
VECTOR COMPONENTS
CORRECT?

.Y .N

#420

#430

#440

#450

658

R56/SKYLARK

659

735
R56/SKYLARK

Z PL - SAME AS
X PL FOR Z
COMPONENT.

#460

WAIT FOR KEY-
BOARD ENTRY

KEY IN
PROCEED

#470

TERMINATE
FLASH UPON
RECEIPT OF
PROCEED OR NEW
DATA.

KEY IN V25E AND
LOAD CORRECT
POSITION VECTOR
COMPONENTS

#480

.P .NEW
.R .DATA
.O .
.C .
.E .
.E .LOAD DATA
.D .

#490

EXIT
R56

EXIT
R56

#500

CHANGE CONTROL NOTES

REV 00 PCR 043,413,414,415, PCN 410,436
REV 01 PCN 489

R56/SKYLARK

737

661

REV 01 03/20/72

ATTITUDE MANEUVER ROUTINE (R6C)

PURPOSE:

(1) TO MANEUVER THE DWS/CSM OR CSM ALONE TO AN ATTITUDE SPECIFIED BY THE PROGRAM IN PROGRESS.

ASSUMPTIONS:

(1) THE FINAL ATTITUDE DESIRED, DEFINED AS FOLLOWS, HAS BEEN STORED BY THE CALLING PROGRAM:
(A) A SPECIFIC BODY FIXED VECTOR AND A DIRECTION IN SPACE TO WHICH THIS VECTOR IS TO BE ALIGNED (THE 3AXISFLG IS RESET).

(B) A THREE AXIS (ORTHOGONAL) INERTIAL ORIENTATION TO WHICH THE THREE BODY AXES ARE TO BE ALIGNED (THE 3AXISFLG IS SET).

(2) THE MANEUVER MAY BE PERFORMED AUTOMATICALLY BY THE GNCS OR PERFORMED MANUALLY WITH AN OPTIONAL FINAL AUTOMATIC GNCS CONTROLLED TRIM MANEUVER. THIS OPTIONAL TRIM MANEUVER SHOULD BE CONSIDERED ESSENTIAL FOR MANEUVERS TO SPS THRUSTING ATTITUDES.

(3) THE DAP DATA LOAD ROUTINE (R03 OR R04) HAS BEEN PERFORMED PRIOR TO THIS ROUTINE.

(4) THE ROUTINE IS AUTOMATICALLY SELECTED BY THE PROGRAM OR ROUTINE REQUIRING THE ATTITUDE MANEUVER.

(5) IF THIS ROUTINE WAS SELECTED BY THE TRACKING ATTITUDE ROUTINE (R61) THE V06N18 AND THE V06N18 IN THIS ROUTINE ARE PRIORITY DISPLAYS. THE V06N18 DISPLAY WILL REMAIN UP A MINIMUM OF 2 SECONDS. RESPONSE AFTER 2 SECONDS WILL CAUSE THE PROGRAM TO CONTINUE AS DESCRIBED.

(6) DURING ANY AUTOMATIC MANEUVER, A MIDDLE GIMBAL ANGLE GREATER THAN OR EQUAL TO 75 DEG (MAGNITJDE) CAUSES THE RCS DAP TO TERMINATE THE MANEUVER AND MAINTAIN ATTITUDE HOLD (SET STIKFLG3 AND ZERO HOLDFLAG).

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PROG
CONT

CREW

GROUND

CMC

.CMC
.ROUTINE
.SELECTION

...

START ATTITUDE
MANEUVER ROUTINE
(R60)

.

OBTAIN DESIRED
ATTITUDE SPECIFICA-

#10

R60/SKYLARK

• • • •

IS 3AXISFLG SET?

$$\begin{array}{c} y \\ \cdot \quad \cdot \quad \cdot \\ \\ z \\ \cdot \quad \cdot \quad \cdot \end{array}$$

CALCULATE FINAL
VEHICLE ATTITUDE
TO POINT SPECIFIC
BODY FIXED VECTOR
IN DESIRED DIR-
ECTION (VECPONT
ROUTINE) IN SUCH
A WAY AS TO LEAVE
UNCONSTRAINED THE
VEHICLE ATTITUDE
ABOUT THE BODY
FIXED VECTOR.

...

SELECT GIMBAL
ANGLES CORRES-
PONDING TO
PREFERRED
VEHICLE ATTI-
TJDE AND PRES-
ENT IMU ORIEN-
TATION

• • •

HOLD.
.....
SNAP.

FLASH VERB-NOUN TO
REQUEST PLEASE
PERFORM AUTO
MANEUVER:

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
PLEASE PERFORM AUTO

299

R60/SKYLARK

V50-V18
R1-CG ROLL
R2-IG PITCH
R3-MG YAW

OG - FINAL DESIRED
OUTER GIMBAL ANGLE
IN DEGREES TO
NEAREST .01 DEGREES.

IG - FINAL DESIRED
INNER GIMBAL ANGLE
IN DEGREES TO
NEAREST .01 DEGREES

MG - FINAL DESIRED
MIDDLE GIMBAL ANGLE
IN DEGREES TO
NEAREST .01 DEGREES.

MANEUVER AND DISPLAY
OF DESIRED GIMBAL
ANGLES.

DO I WISH TO CONTINUE
IN THIS PROGRAM?

.N .Y

KEY IN
TERMINATE
V34E

REVIEW THE PRESENTLY
DISPLAYED GIMBAL
ANGLES AND THE
PRESENT ATTITUDE. AM
I WITHIN THE PRESENT
RCS DAP DEADBAND
LIMITS IN EACH AXIS?

.N .Y

WAIT FOR KEYBOARD
ENTRY

DO I WISH
TO FURTHER
ADJUST THE
VEHICLE
ATTITUDE
ABOUT THE
DESIRED
VECTOR?

#70

#80

#90

#100

#110

#120

#130

#140

#150

#160

(NOT POSSIBLE FOR ALL CASES. SEE ASSUMPTION 1)

.N .Y

KEY IN ENTER

EXIT
R60

SHALL I HAVE THE GNC'S PERFORM THE MANEUVER AUTOMATICALLY?

.Y .N

TERMINATE FLASH UPON RECEIPT OF ENTER, PROCEED, OR TERMINATE

.P .T .E
.R .E .N
.O .R .T
.C .M .E
.E .I .R
.E .N
.D .A
. .T
. .E

IS MAJOR
MODE 00?

.N .Y

WAS THIS ROUTINE CALLED BY P20?

.N .Y

DO ROUTINE R00

#170

#180

#190

#200

#210

R60/SKYLARK

DO P20 TER-
MINATION
PROCESS
(V56 LOGIC).

EXIT
R60

IS 3AXISFLG SET?

.N
.Y

CALCULATE FINAL
VEHICLE ATTITUDE
TO POINT SPECIFIC
BODY FIXED VECTOR
IN DESIRED DIR-
ECTION (VECPNT
ROUTINE) IN SUCH
A WAY AS TO LEAVE
UNCONSTRAINED THE
VEHICLE ATTITUDE
ABOUT THE BODY
FIXED VECTOR.
NOTE: GNCS CAP-
ABILITY TO PER-
FORM MANEUVER
AUTOMATICALLY
WILL BE COMPRO-

SELECT CMC
CONTROL AND
SELECT THE
AUTO MODE.

SHALL I HAVE
THE GNCS
RECOMPUTE THE
DESIRED ATTIT-
UDE WITHOUT
PERFORMING
THE AUTOMATIC
MANEUVER?
(NOT POSSIBLE
FOR ALL
CASES. SEE
ASSUMPTION 1)

.Y
.N

EITHER SELECT
SCS CONTROL

OR PLACE
MODE SWITCH
NOT IN AUTO.

KEY IN
PROCEED

PERFORM
ATTITUDE
MANEUVER
MANUALLY
USING
RHC AND
BY REF-
ERENCE TO
THE OUT
THE WIV-
DOM VIEW
AND/OR
THE FDAI
BALL AND
ATTITUDE
ERROR
NEEDLES.

R60 / SKYLARK

#270

#280

#290

\$300

#310

R60 / SKYLARK

TEMP
HOLD.
••••
SNAP.

DO MANUEVER
CALCULATION
(KALCMANUJ) AND
ICDU DRIVE
ROUTINE TO
ACHIEVE FINAL
GIMBAL ANGLES.
THE MANUEVER
RATE WILL BE
THAT LAST DE-
FINED TO THE
CMC BY DSKY
ENTRY. THIS
PROCESS WILL
INCLUDE A MON-
ITOR OF THE
RHC INPUTS TO
THE CMC. ANY
INPUT FROM THE
RHC WILL BE
INTERPRETED AS
A MANUAL OVER-
RIDE AND WILL
CAUSE IMMEDIATE TERMINA-
TION OF THIS
MANUEVER CAL-
CULATION AND
ICDU DRIVE
ROUTINE.

COMMAND ZERO VEHICLE
RATE

IS HOLD FLAG
NEGATIVE?

MONITOR ATTITUDE
MANEUVER BY
REFERENCE TO FDI
BALL AND ATT-
TITUDE ERROR
NEEDLES TO AVOID
GIMBAL LOCK.

SHALL I OVERRIDE
THE GNCS AND
COMPLETE THE MAN-
EUVER MANUALLY?

z . .

y . .

WAIT FOR
AUTOMATIC
COMPLETION.

IS THIS A
P20 MANEU-
VER DURING
MINKEY?

YES	NO
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

EXIT R60

669

745
R60/SKYLARK

SET HOLDFLAG ZERO

SET DAP REFERENCE
TO DESIRED DAP
CDUS

IS TRACK FLAG SET?

NO. YES

IS THIS
MINKEY?
(IS AUTO-
SEQ FLAG
SET?)

NO YES

EXIT R60

PERFORM ATTITUDE
MANEUVER MANUALLY
USING RHC AND BY
REFERENCE TO THE
OUT-THE-WINDOW-
VIEW AND/OR THE
FDAI BALL AND ATT-
ITUDE ERROR NEED-
LES.

#370

#380

#390

#400

R60/SKYLARK

.....

746
R60/SKYLARK

#410

CHANGE CONTROL NOTES

REV 00 PCR 040, PCN 456
REV 01 PCN 489

670

R60/SKYLARK

#30

IS R61 COUNTER
NEGATIVE?

.N .Y

EXIT

#40

DECREMENT R61
COUNTER BY ONE.

EXIT

#50

LOAD DEADBAND WITH
R2 OF N79 OR SET
DEADBAND TO MINIMUM
IF ZERO WAS LOADED
IN R2 OF N79

#60

SET DESIRED TIME =
PRESENT TIME.

#70

• • • • •

SAVE DAP REFERENCE
ANGLES FOR LATER USE

• • • • •

ND"
FROM
BELOW

• •

EXTRAPOLATE CSM
STATE VECTOR TO
DESIRED TIME
USING CONIC
EQUATIONS

• • • •

IS UTFLAG SET?

 γ
 z

EXTRAPOLATE QWS
ESTIMATE VECTOR TO
DESIRED TIME
USING CONIC
EQUATIONS

• • •

IS AZIM- IS AZIM-
FLAG FLAG

08#

0690

06130

0110

BODY.) THIS ATTITUDE WILL BE COMPUTED (VECPNT) TO POINT THE DESIRED UNIT VECTOR AT THE CELESTIAL BODY BUT WILL NOT CONSTRAIN THE NONCRITICAL ORIENTATION ABOUT THAT VECTOR.

A 10x10 grid of dots. The top row (row 1) and the first three columns (columns 1, 2, and 3) are highlighted in black. This represents the first three terms of the sequence for each of the first ten natural numbers.

19B70

CALCULATE DESIRED TRACKING ATTITUDE FROM CSM TO OWS (DESIRED UNIT VECTOR ALIGNED WITH LOS FROM CSM TO OWS). THIS ATTITUDE WILL BE COMPUTED TO POINT THE DESIRED UNIT VECTOR AT THE OWS AND WILL CONSTRAIN THE ORIENTATION ABOUT THAT VECTOR.

• • •

22

0210

#180

#190

#200

#210

R61/SKYLARK

#250

STORE ATTITUDE SPECIFICATION FOR

755
REL/SKYLARK

229

DESIRED TRACKING
ATTITUDE FOR USE BY
THE ATTITUDE MANEU-
VER ROUTINE (R60).

#260

#270

SET EXCHANGE (RANGE
ESTIMATE AVAILABLE
FROM STATE VECTORS)

#280

IS P27 IN MODE
LIGHTS?

$$\begin{array}{c} y \\ \bullet \quad \bullet \quad \bullet \\ \\ z \\ \bullet \quad \bullet \quad \bullet \end{array}$$

TURN OFF UPLINK
ACTY LIGHT

#290

IS HOLDFLAG EQUAL TO
A POSITIVE, NON-ZERO
NUMBER?

$$\begin{array}{c} y \\ \cdot \quad \cdot \quad \cdot \\ \\ z \\ \cdot \quad \cdot \quad \cdot \end{array}$$

```
RESET V50N18
FLAG
```

#310

R61/SKYLARK

GO TO
"A"
BELOW

#320

IS OPTION 3 OR 1?

YES . NO

#330

COMPARE DESIRED
LOS DIRECTION
WITH DIRECTION
OF S/C VECTOR TO
BE POINTED
(ASSUMING CSM IS
AT DAP REFERENCE
ATTITUDE SAVED
ABOVE)

0463

COMPARE DESIRED
CDUS WITH SAVED
DAP REFERENCE
ANGLES

#350

IS ANGLE CHANGE(S)
GREATER THAN 10
DEGREES?

Y.
Z.

829

R61/SKYLARK

629

757
R61/5KYLARK

#360

#370

#380

390

0048

R61/SKYLARK

#410

#420

#430

#440

#450

#460

"A"

SET R61
COUNTER EQUAL
TO 3.

EXIT

IS THE PRIORITY
DISPLAY IN ROU-
TINE 22 USING
THE DSKY?

.Y .N

SET R61 COU-
NTER EQUAL
TO -1.

EXIT

IS AZIMFLAG SET?

.Y .N

189

SET 3AXISFLG

RESET 3 AXIS-
FLG

RESET V50N18 FLAG

DO ATTITUDE MANEUVER
ROUTINE (R60).DO ATTITUDE MANEUVER
ROUTINE (R60).

BLANK DSKY
EXCEPT FOR MAJOR
MODE

SET R61 COUNTER
EQUAL TO 0.

EXIT

0445

८१
८२
८३
८४

4490

0650

4510

z . . .

y . . .

y

z

.....

R61/SKYLARK

REV 00 05/19/71

CREW-DEFINED MANEUVER ROUTINE (262)

PURPOSE: (1) TO PROVIDE THE CREW WITH THE ABILITY TO SPECIFY A FINAL VEHICLE ATTITUDE FOR USE BY A CMC-CONTROLLED ATTITUDE MANEUVER.

ASSUMPTIONS: (1) THE ROUTINE IS MANUALLY SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

(2) THE CAP DEADBAND DURING THIS ROUTINE IS AS DEFINED BY THE LOAD CAP DATA ROUTINE (R03 OR R04).

(2) THIS ROUTINE CAN ONLY BE ENTERED FROM THE CMC IDLING PROGRAM (P00).

PROG
CONT

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CREW

- CREW
- ROUTINE
- SELECTION
-

KEY IN V49E

START CREW-DEFINED
MANEUVER ROUTINE
(R62)

IS CURRENT PROGRAM
P00?

$$z_{\gamma}$$

IS ANOTHER EXTENDED VERB, A MARKING DISPLAY, OR A PRIORITY DISPLAY ACTIVE?

•
•
•

MONITOR DSKY: DOES
OPERATOR ERROR LIGHT
COME ON INDICATING
THAT THIS ROUTINE
CANNOT BE SELECTED
AT THIS TIME?

 γ

PRECEDING PAGE BLANK NOT FILMED

R62/SKYLARK

REV CC 05/19/71

21) TO CALCULATE THE FINAL GIMBAL ANGLES REQUIRED TO POINT THE SPECIFIED AXIS AT THE DWS.

3) TO CALL THE ATTITUDE MANEUVER ROUTINE (R60) FOR AUTOMATIC MANEUVER CAPABILITY.

(2) TO SAVE TIME THE CSM ATTITUDE CONTROL MODE SHOULD BE PRESELECTED (FOR AUTOMATIC MANEUVERS R03 SHOULD HAVE BEEN DONE AND THE CMC AUTO MODE SELECTED).

(4) THIS ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

```

PROG          CREW          GROUND          CMC          PRG
CONT          .CREW          .ROUTINE        .SELECTION
              .              .              .
              .              .              .
              .              .              .
              .              .              .

```

START RENDEZVOUS
FINAL ATTITUDE
RCUTINE (R63)

KEY IN V89E

IS THE CURRENT PROGRAM POSSIBLE?

YES.

NO.

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#10

第20

#30

IS ANOTHER EX-
TENDED VERB, A
MARKING DISPLAY,
OR A PRIORITY
DISPLAY ACTIVE?

N.
Y.

TURN ON
OPERATOR ERROR
LIGHT

MONITOR DSKY:
DOES OPERATOR
ERROR LIGHT COME ON,
INDICATING THAT THIS
ROUTINE CAN NOT BE
SELECTED AT THIS
TIME?

.Y .N

EXIT
R63

#50

IN ORDER TO TURN
THIS ROUTINE ON
SELECT CMC IDLING
PROGRAM (POO) BY
KEYING V37E00E
AND RESELECT THIS
ROUTINE

#60

EXIT
R63

#70

DO IMU STATUS CHECK
ROUTINE (R02)

DO IMU STATUS CHECK
ROUTINE (R02)

691

769
R63/SKYLARK

RESET AZIMFLAG

SET ASSUMED AXIS TO:
GAMMA=0
RHO=0

FLASH VERB-NOUN TO
REQUEST RESPONSE AND
DISPLAY DESIRED
POINTING AXIS:
V06N78
R1-GAMMA
R2-RHO
R3-BLANK

ALL ANGLES IN
DEGREES TO THE
NEAREST .01 DEGREE.

WAIT FOR KEYBOARD
ENTRY

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

NEW PROCEED
DATA

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
DESIRED POINTING
AXIS.

IS THE DATA CORRECT?

YES NO

KEY IN
PROCEED

KEY IN V24E AND
LOAD NEW DATA

#80

#90

#100

#110

#120

R63/SKYLARK

STORE
DATA

0410

#150

#160

#170

R63/SKYLARK

692

#180

#190

\$200

#210

#220

R63/SKYLARK

CRAFT TO THE
DESIRED ATTITUDE?

.Y .N

DO I WISH TO
UPDATE THIS
DISPLAY?

.Y .N

WAIT FOR KEYBOARD
ENTRY

KEY IN
RECYCLE
V32E

TO TERMINATE
THIS ROUTINE
KEY IN
V34E

TERMINATE FLASH UPON
RECEIPT OF PROCEED,
RECYCLE OR TERMINATE

KEY IN
PROCEED

.P .T
.R .E
.D .R
.C .M
.Y .C
.C .I
.L .N
.E .A
.E .T
. . .
. . .
EXIT

EXIT
R63

#230

#240

#250

#260

#270

OPTICS ANGLES TRANSFORM ROUTINE (R64)

REV 01 03/20/72

PURPOSE:

- (1) TO DISPLAY AT ASTRONAUT REQUEST THE TRACKING ANGLES CORRESPONDING TO GIVEN OPTICS ANGLES. TRACKING ANGLES (N78) SPECIFY THE SPACECRAFT AXIS TO BE POINTED BY THE TRACKING PROGRAM.
- (2) TO AUTOMATICALLY ALTER THE SPACECRAFT TRACKING AXIS (AS CONTAINED IN N78) SINCE R61 CONSTRUCTS THE TRACKING VECTOR FROM THE CONTENTS OF N78.

ASSUMPTIONS:

- (1) OPTICS ANGLES WILL REMAIN CONSTANT DURING THE TRACKING.
- (2) THE ROUTINE IS SELECTED BY THE ASTRONAUT BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW

- CREW
- ROUTINE
- SELECTION
-
-
-

START OPTICS ANGLES
TRANSFORM ROUTINE
(R64)

•

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

• N

Y.

•

• TURN ON OPER-
ATOR ERROR

KEY IN V64E

#10

#20

Preceding page blank

PRECEDING PAGE BLANK NOT FILMED

80

065

0013

0110

#120

R64 / SKYLARK

REV 01 03/20/72

ROTATION ROUTINE (R67)

PURPOSE: (1) TO COMPUTE THE DAP COMMANDS FOR THE CSM WHICH ENABLES ROTATION OF THE CSM ABOUT THE SPECIFIED AXIS.
 (2) TO PERFORM THE ROTATION MANEUVER.

ASSUMPTIONS: (1) THE ROUTINE IS CALLED BY THE UNIVERSAL TRACKING PROGRAM (P20), FOR OPTION 2.

PROG CONT	CMC	GROUND	CREW
--------------	-----	--------	------

.CMC
 .ROUTINE
 .SELECTION
 .

START ROTATION
 ROUTINE (R67)

#10

SET R67FLAG

#20

IS S/C CONTROL CMC?

.Y .N

IS THE AUTO MODE
 SELECTED?

.Y .N

#30

703

CDUS : CDUS

WAIT ONE SECOND

LOAD DEADBAND WITH
R2 OF N79 OR SET
DEADBAND TO MINIMUM
IF ZERO WAS LOADED
IN R2 OF N79

W A 11

IS TRACK FLAG SET?

2

RESET R67FLAG

COMMAND ZERO
VEHICLE RATE

+ + 01 + + 489 + +

#90

#100

017*

120

4130

R67/SKYLARK

#180

R67/SKYLARK

705

785
R67/SKYLARK

R67

COMPUTE ROTATION
MATRIX

#190

SET HOLDFLAG
NEGATIVE

#200

COMPUTE DAP COMMANDS
FOR GNF CYCLE OF
KALCMANU.

#210

IS TRACK FLAG SET?

#220

IS HOLDFLAG
NEGATIVE?

#230

R67/SKYLARK

++
+ 01
+
+
+
+
+
+
+
+ 489
++

052#

#250

#260

012*

#280

902

R67/SKYLARK

REV 01 03/20/72

TEST DSKY LIGHTS VERB 35

++

+01

PURPOSE:

+

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(1) TO CHECK THAT ALL THE DSKY LIGHTS ARE WORKING PROPERLY.

ASSUMPTIONS: (1) THE STATUS OF THE DSKY LIGHTS MAY BE CHECKED ONLY WHILE IN P00.

PROG
CONT

CYC

GROUND

CREW

.CREW
.SELECTION

START CREW INITIATED
TEST OF DSKY LIGHTS

KEY IN V35E

IS THE PRESENT
PROGRAM P00?

.Y

.N

TURN ON
OPERATOR
ERROR LIGHT

EXIT

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#10

#20

#30

V35/SKYLARK

REV 01 03/20/72

REQUEST FRESH START VERB 35

- PURPOSE: (1) TO INITIATE A COMPUTER FRESH START
- ASSUMPTIONS: (1) FRESH START IS CREW INITIATED BY DSKY ENTRY.
- (2) IF A FRESH START INTERRUPTS STATE VECTOR INTEGRATION, THE STATE VECTOR MAY BE INVALIDATED.
- (3) THIS PROCESS MAY BE SELECTED AT ANY TIME.

PRG
CONT

CMC

GROUND

CREW

CREW
SELECTION

++
+01
+
+
+489
++

START CREW INITIATED KEY IN V36E
FRESH START

ZERO OUTBIT CHANNELS
5 (RCS PITCH AND
YAW) AND 6 (RCS
ROLL)

ZERO CHANNEL 77

010

020

#30

#40

#50

#60

#70

#80

SET TIME 3 = 3777
TIME 4 = 3775
TIME 5 = 3774

TERMINATE WAITLISTED
TASKS

CLEAR ALL EXECUTIVE
REGISTER SETS

INDICATE NO ACTIVE
JOBS

MAKE ALL VAC AREAS
AVAILABLE

BLANK DSKY REGISTERS
(PROGRAM, VERB,
NOUN, R1, R2, R3.)

OBSERVE DSKY
REGISTERS BLANK

++
+01
+
+489
++

797
V36/SKYLARK

• • • • •

EXE

CHANGE CONTROL NOTES

V36/SKYLARK

REV 01 03/20/72

ZERO IMU CDU EXTENDED VERB 43

- PURPOSE:
- (1) TO INSURE SYNCHRONIZATION BETWEEN THE ISS CDU COUNTERS AND THE CDU COUNTERS IN THE COMPUTER.
 - (2) TO TERMINATE THE IMU COARSE ALIGN MODE AND ENTER THE FINE ALIGN MODE (INERTIAL IMJ).
- ASSUMPTIONS:
- (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
 - (2) THE PROCESS MAY NOT BE SELECTED IF THE ISS IS IN THE COARSE ALIGN MODE AND IN SIMBAL LOCK.
 - (3) THE PROCESS IS INTENDED PRIMARILY FOR USE ON THE GROUND.

PROG
CONT

CMC

GROUND

CREW

CREW
SELECTION

++
+01
++
++
++
++
++
++489
++

START CREW INITIATED
ZERO IMJ CDU

IS MODE SWITCHING
OR GYRC TORQUING
IN PROCESS?

.N
.Y
.
.
.

TURN ON
OPERATOR ERROR

KEY IN V40E

#10

#20

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028

812

ENTER CDU ZERO
MODE

Y
EXIT
Z

719

801
V40/SKYLARK

+01
+
+
+
+
+
+
+
+
+489
+
+

TURN OFF NO ATT
LIGHT

WAIT 320 MSEC

CLEAR ISS CDU
READ COUNTERS

ENTER FINE
ALIGN MODE

WAIT APPROXIMATELY
8 SEC

EXIT

OBSERVE NO ATT
LIGHT OFF

EXIT

#80

#90

#100

#110

CHANGE CONTROL NOTES

REV 01 PCN 489

V40/SKYLARK

COARSE ALIGN CDU EXTENDED VERB 41 (WITH N20) REV 01 03/20/72

PURPOSE:

- (1) TO ALIGN THE IMU TO GIMBAL ANGLES SPECIFIED BY THE ASTRONAUT.
- (2) TO COARSE ALIGN TO 0.0.0 WHEN IN GIMBAL LOCK AND COARSE ALIGN.

ASSUMPTIONS:

- (1) THE PROCESS IS CREW SELECTED BY USKY ENTRY.
- (2) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.
- (3) THE ACCURACY OF THE ALIGNMENT IS TESTED TO A TOLERANCE OF +2 DEGREES. IF THIS TOLERANCE IS EXCEEDED, THE ASTRONAUT WILL BE NOTIFIED VIA A PROGRAM ALARM.
- (4) V41 MAY ONLY BE USED WITH N20 OR N91. REFER TO OPTICS COARSE ALIGN EXTENDED VERB (V41N91).
- (5) THE PROCESS SHOULD NEVER BE USED DURING A PROGRAM WHICH REQUIRES THAT THE IMU BE ON AND ALIGNED.

PROG
CONT

CMC GROUND CREW

.CREW
.SELECTION

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START CREW INITIATED
COARSE ALIGN CDU

KEY IN V41N20E

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

.N .Y

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#10

#20

#30

#40

#50

#60

722

V4IN20/SKY

TURN ON
OPERATOR
ERROR LIGHT

EXIT

FLASH VERB-NOUN TO
REQUEST LOAD OF
DESIRED CDU ANGLES.
V2IN22
R1-OG ROLL
R2-IG PITCH
R3-MG YAW

ALL REGISTERS
INITIALLY BLANK

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH REQUESTING
LOAD OF CDU ANGLES

#70

ALL ANGLES IN DE-
GREES TO NEAREST .01
DEGREE

SHALL I LOAD CDU
ANGLES?

.Y .N

WAIT FOR KEYBOARD
ENTRY

#80

LOAD DESIRED
ANGLES

TERMINATE FLASH UPON
RECEIPT OF DATA OR
V33E

KEY IN
V33E

#90

.DATA .V

. .3

. .3

. .E

. .

. .

. .

. .

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. .

. .

MONITOR DSKY:
OBSERVE DISPLAY OF
COARSE ALIGN VERB

#100

DISPLAY COARSE ALIGN
VERB
V41

#110

IS MUDE SWITCHING OR
GYRO TORQUING IN
PROGRESS?

N. .Y

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#120

ENTER C/JARSE ALIGN
MCDE

TURN ON NO ATT LIGHT

OBSERVE NO ATT
LIGHT ON

A diagram consisting of a vertical line on the left and a horizontal line at the bottom. There are four dots on the vertical line and four dots on the horizontal line, with one dot at each of the four intersections.

IS THE IMU BEING
INITIALIZED?

Y . . . EXIT
N . . .

#150

COARSE ALIGN IMU TO
STORED ANGLES (15
SECS MAX)

WAIT 1.5 SECONDS

READ PRESENT IMU OR-
IENTATION W.R.T. THE

#170

725

807
V41N20/SKY

VEHICLE.
(GIMBAL ANGLES)

.

ARE THE GIMBALS
WITHIN 2 DEGREES OF
THE DESIRED ANGLES?

.Y .N

TURN ON PROGRAM
ALARM AND STORE
ALARM CODE
(00211)

.
.
.
...
.
EXIT

...
.
EXIT

MONITOR DSKY:
DOES PROGRAM ALARM
INDICATE THAT THE
IMU GIMBALS DID NOT
DRIVE TO WITHIN 2
DEGREES OF THE DE-
SIRED ANGLES?

.N .Y
.
.
...
EXIT

CHECK STATUS OF CW
PANEL. IS AN ISS
MALFUNCTION
INDICATED?

.Y .N
.
.
...
EXIT

DO I DESIRE TO
RESELECT THE

#180

#190

0200

0210

#220

V41N20/SKY

COARSE ALIGN CDU EXTENDED VERB 41 (WITH N91) REV 00 05/19/71

PURPOSE:

(1) TO DRIVE THE OPTICS TO SHAFT AND TRUNNION ANGLES SPECIFIED BY THE ASTRONAUT.

ASSUMPTIONS:

- (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
- (2) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.
- (3) THE PROCESS MAY BE SELECTED ONLY WHEN THE CMC IS IN THE CMC IDLING PROGRAM (P00).

PROG
CONT

CMC

GROUND

CREW

CREW
SELECTION

START CREW INITIATED
OSS COARSE ALIGN

KEY IN V41N91E

#10

IS CURRENT PROGRAM
P00?

.Y .N

#20

TURN ON
OPERATOR
ERROR LIGHT

#30

○ 今 日

050

090

040

80

822

V41N91/SKY


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TERMINATE FLASH UPON      .          .
RECEIPT OF DATA         ..... KEY IN
OR V33E                   .          V33E

```

.DATA .V

DATA	V
.	3
.	3
.	E

USE ANGLES
IN SAC, PAC

DISPLAY COARSE
ALIGN VERB
V41

MONITOR DSKY:
OBSERVE DISPLAY
OF COARSE ALIGN
VERB

ENABLE CMC POSITION-
ING OF OPTICS TO
DESIRED ANGLES

EXIT

EXIT

CHANGE CONTROL NOTES

#150

#160

#170

#180

PULSE TORQUE GYROS EXTENDED VERB 42 REV 01 03/20/72

PURPOSE:

- (1) TO FINE ALIGN THE STABLE MEMBER BY TORQUING THE GYROS.
- (2) TO TERMINATE THE COARSE ALIGN MODE AND ENTER THE INERTIAL MODE.

ASSUMPTIONS:

- (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
- (2) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.
- (3) THE PROCESS IS INTENDED PRIMARILY FOR USE ON THE GROUND.

PROG
CONT

CMC

GROUND

CREW

DO I DESIRE TO LOAD
A DELTA GYRO ANGLE
GREATER THAN +99.999
DEGREES? -

.Y .N
.
.

#10

THE ASTRONAUT
MUST LOAD THE
THREE DOUBLE PRE-
CISION OGC
REGISTERS:

KEY V21N02E
02757E
XXXXXE
N15E
XXXXXEE
YYYYYEE
YYYYYEE
ZZZZZEE
ZZZZZEE

BIT 14 OF THE
HIGH ORDER RE-

#20

PRESENTS 180
DEGREES; BIT
13, 90 DEGREES;
ETC.
THE MAXIMUM NE-
GATIVE GYRO
TORQUING ANGLE
IS 37777,
37743; THE MAX-
IMUM POSITIVE
GYRO TORQUING
ANGLE IS 40000,
40034. ANY
ANGLE OF GREAT-
ER MAGNITUDE
THAN THE GIVEN
MAXIMUM WILL
RESULT IN A
COMMANDED TOR-
QUING ANGLE OF
ZERO.
(NOTE: THE
LOADING OF TOR-
QUING ANGLES
GREATER THAN 90
DEGREES SHOULD
NOT BE PERFORM-
ED DURING
FLIGHT. THIS
PROCEDURE IS
INTENDED FOR
USE ON THE
GROUND.)

START CREW INITIATED
PULSE TORQUE GYROS

++
+01
+
+
+489
++

KEY V42E

.....

.....

.....

#30

#40

#50

#60

#70

IS ANOTHER EXTENDED VERB, A MARKING DISPLAY, OR A PRIORITY DISPLAY ACTIVE?

-N .Y

TURN ON OPERATOR ERROR LIGHT

EXIT

FLASH VERB-NOUN TO REQUEST LOAD OF DELTA GYRO ANGLES V21N93
R1-DELTA GYRO X
R2-DELTA GYRO Y
R3-DELTA GYRO Z

ALL REGISTERS INITIALLY BLANK

DELTA GYRO ANGLES - THE ANGLES THROUGH WHICH EACH GYRO MUST BE TORQUED TO COM-

MONITOR DSKY: OBSERVE VERB-NOUN FLASH REQUESTING LOAD OF DELTA GYRO ANGLES

DID I LOAD THE GYRO TORQUING REGISTERS

#80

#90

#100

#110

#120

EXIT
.....

CHANGE CONTROL NOTES

736 V42/SKYLARK

LOAD FDAI ATT ERROR NEEDLES (TEST ONLY)
EXTENDED VERB 43 REV 00 05/19/71

- PURPOSE: (1) TO LOAD ASTRONAUT SPECIFIED ANGLES INTO THE FDAI ATTITUDE ERROR NEEDLES.
- ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.
- (2) IF LIFTOFF HAS OCCURRED, THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE. IF LIFTOFF HAS NOT OCCURRED, ANY OTHER EXTENDED VERB IN PROCESS WILL BE OVERRIDDEN.
- (3) THE PROCESS MAY NOT BE SELECTED IF THE IMU IS IN THE COARSE ALIGN OR ZERO ICDJ MODE.
- (4) THE PROCESS IS INTENDED PRIMARILY FOR USE ON THE GROUND.
- (5) THE MAXIMUM ERROR ANGLE WHICH MAY BE LOADED IS +/- 16.88 DEGREES. ANY VALUE GREATER THAN THIS MAXIMUM WILL BE INTERPRETED AS 16.38 DEGREES. THE ASTRONAUT SHOULD SELECT THE FDAI SCALE APPROPRIATE TO THE ERROR ANGLES HE WISHES DISPLAYED. THE MAXIMUM ANGLES WHICH MAY BE SHOWN ON THE ERROR NEEDLES ARE: PITCH AND YAW -15 DEGREES; ROLL -50 DEGREES.
- (6) THE PROCESS MAY BE SELECTED ONLY IN POO.

PROG
CONT

CMC GROUND CREW

CREW
SELECTION

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START CREW INITIATED KEY IN V43E
LOAD FDAI ATTITUDE .
ERROR NEEDLES

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. .
. .

IS THE CMC IDLING
PROGRAM (POO) IN

SET ERROR COUNTER
ENABLE

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.
.
.

WAIT 20 MILLISECONDS

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.
.

LOAD ISS ERROR
COUNTERS

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.
.
.
.
EXIT

#130

#140

#150

EXIT

CHANGE CONTROL NOTES

REQUEST DOCKED DAP DATA -DAD ROUTINE (R04)
EXTENDED VERB 44

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE
R04. SEE R04 FOR SPECIFICATION LOGIC FLOW FOR
LOADING DAP DATA.

CHANGE CONTROL NOTES

REV 00 PCR 007,040

ACTIVATE DOCKED DAP EXTENDED VERB 45

PURPOSE: (1) TO ACTIVATE DOCKED RCS DAP.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG CONT	CMC	GROUND	CREW
			.CREW .SELECTION
		.	.
		.	.
	
		.	.
		KEY IN V45E
	START CREW INITIATED	.	.
	ACTIVATION OF DOCKED	.	.
	RCS DAP	EXIT
	IS THIS P40?		
	N		
	Y		
	.		
	.		
	TURN ON		
	OPERATOR		
	ERROR LIGHT		
	.		
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	.		
	EXIT		

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430

.....

DISABLE SIVB
TAKEOVER

.....

ESTABLISH DOCKED RCS
DAP

.....
EXIT

#40

#50

CHANGE CONTROL NOTES

REV 00 PCR 007,040

REV 00 05/19/71

ACTIVATE CSM DAP EXTENDED VERB 46

PURPOSE: (1) TO ACTIVATE THE CSM DAP.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG CONT	CMC	GROUND	CREW
			CREW SELECTION
			.
			.
			...
			.
			.
			...
			EXIT

START CREW INITIATED
ACTIVATION OF CSM
DAP

KEY IN V46E

IS TVC DAP ON?

N
Y
IS VEHICLE CON-
FIGURATION 2 OR
6?

Y
V
TURN ON
OPERATOR
ERROR

010

020

030

CONTROL STICK	(TO OWS) RCS DAP
.	.
.	.
.	.
...	...
EXIT	EXIT

CHANGE CONTROL NOTES

REV 00 PCR 040, PCN 410

SET OWS STATE VECTOR INTO CSM STATE VECTOR
EXTENDED VERB 47
REV 00 05/19/71

PURPOSE: (1) TO TRANSFER THE OWS STATE VECTOR INFORMATION TO THE CSM STATE VECTOR.

ASSUMPTIONS: (1) THIS TRANSFER OF THE STATE VECTOR INFORMATION MAY BE ACCOMPLISHED AT ANY TIME EXCEPT WHEN AVERAGE-3 IS ON.
(2) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG
CONT

CWC

GROUND

CREW

.CREW
.SELECTION
.
.
...

START CREW INITIATED
STATE VECTOR TRANS-
FER. (OWS TO CW)

KEY IN V47E

EXIT

IS INTEGRATION IN
PROCESS?

.Y .N

COMPLETE
INTEGRATION

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#10

#20

#30

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. .

TRANSFER OTHER
VEHICLE STATE VECTOR
TO THIS VEHICLE
STATE VECTOR.

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. .
...
. .
EXIT

CHANGE CONTROL NOTES

842
V47/SKYLARK

#40

#50

750
V47/SKYLARK

REQUEST CSM DAP DATA LOAD (R03)
EXTENDED VERB 48
REV 00 05/19/71

NOTE: THIS EXTENDED VER3 IS USED TO CALL ROUTINE
R03. SEE R03 FOR SPECIFICATION LOGIC FLOW
FOR LOADING DAP DATA.

CHANGE CONTROL NOTES

REV 00 05/19/71

START CREW-DEFINED MANEUVER (R62)
EXTENDED VERB 49

NOTE: THIS EXTENDED VER3 IS USED TO CALL ROUTINE
R62. SEE R62 FOR THE SPECIFICATION LOGIC FLOW
FOR A CREW DEFINED MANEUVER.

CHANGE CONTROL NOTES

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PLEASE PERFORM EXTENDED VERB 50

REF 00 05/19/71

PURPOSE: (1) TO INTERRUPT A PROGRAM OR ROUTINE TO ALLOW THE ASTRONAUT TO MANUALLY ACCEPT OR REJECT THE INFORMATION DISPLAYED ON THE DSKY.

ASSUMPTIONS: (1) PRESSING PROCEED ON DSKY INDICATES REQUESTED ACTION HAS BEEN PERFORMED.

(2) EXECUTION OF ENTER INDICATES THE REQUESTED ACTION IS NOT DESIRED.

(3) THIS VERB ALWAYS APPEARS FLASHING ON THE DSKY.

(4) THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

NOTE: THIS VERB IS COMPLETELY DESCRIBED IN SECTION 4.2

CHANGE CONTROL NOTES

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PLEASE MARK EXTENDED VERB 51

REV 00 05/19/71

PURPOSE:

(1) TO ALLOW THE ASTRONAUT TO OBTAIN OPTICAL SIGHTING DATA BY USE OF THE SXT, SCT, AND THE MARK BUTTON.

ASSUMPTIONS: (1) OPTICS IS ON AND OPERATIONAL.

(2) THIS VERB IS USED IN P03 AND R53. REFER TO THOSE PURPOSES AND ASSUMPTIONS FOR ADDITIONAL RESTRICTIONS.

(3) THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

NOTE: THIS VERB IS COMPLETELY DESCRIBED IN SECTION 4.2

CHANGE CONTROL NOTES

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PLEASE MARK ALTERNATE LOS EXTENDED VERB 53

REV 00 05/19/71

PURPOSE:

(1) TO ALLOW THE ASTRONAUT TO OBTAIN OPTICAL SIGHTING DATA BY USE OF ANY DESIGNATED ALTERNATE LINE OF SIGHT.

ASSUMPTIONS:

(1) THIS VERB IS USED IN R23 AND R56 ONLY.
REFER TO THE PURPOSES AND ASSUMPTIONS OF THESE ROUTINES FOR ADDITIONAL RESTRICTIONS.

(2) THIS VERB IS INTERNALLY GENERATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

NOTE: THIS VERB IS COMPLETELY DESCRIBED IN SECTION 4.2

CHANGE CONTROL NOTES

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START RENDEZVOUS BACKUP SIGHTING MARK (R23)
EXTENDED VERB 54 REV 00 05/19/71

NOTE: THIS EXTENDED VER3 IS USED TO CALL ROUTINE
R23. SEE R23 FOR THE SPECIFICATION LOGIC FLOW
FOR RENDEZVOUS BACKUP SIGHTING MARK PROCESS.

CHANGE CONTROL NOTES

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INCREMENT CMC TIME (DECIMAL) EXTENDED VERB 55

REV 01 03/20/72

PURPOSE:

(1) TO CHANGE THE CMC CLCK TIME USING INCREMENTS (OR DECREMENTS) LOADED BY THE ASTRONAUT.

ASSUMPTIONS:

(1) THE PROCESS MAY BE SELECTED ONLY WHEN NO OTHER EXTENDED VERB IS ACTIVE.

(2) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG
CONT

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GRUND

MEM

NOTES
CREW SELECTION

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START CREW INITIATED
CHANGE OF CMC CLOCK

KEY IN V55E

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

Y.
Z.

TURN ON
OPERATOR
ERROR LIGHT

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010

第20

030

764 V55 / SKYLARK

REV 01 03/20/72

TERMINATE TRACKING EXTENDED VERB 56

PURPOSE:

- (1) RESET UNIVERSAL TRACKING, R67 FLAGS. TURN OFF MINKEY SEQUENCE (CLEAR AUTOSEQ).
- (2) TERMINATE PROGRAM P20.

ASSUMPTIONS:

- (1) THIS PROCESS MAY BE ENTERED VIA TERMINATE OPTION OF V06 N49 IN R22, AND THE TERMINATE OPTION OF THE MANEUVER DISPLAY IN R60 IF ENTERED FROM R61.
- (2) PROCESS MAY BE CREW SELECTED BY DSKY ENTRY.

PROG
CONT

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CMC	GROUND	CREW
.CMC		.CREW
.GOTOV56		.SELECTION
.SELECTION		.
.		.
...		...
.		.
START CREW INITIATED	KEY IN V56E
TERMINATE TRACKING		
PROCESS		
.		.
.		.
RESET R57FLAG		
.		.
.		.
IS UTFLAG SET?		
.NO	.YES	
.	.	.
.	.	.
.
.	.	.
IS RENDEZVOUS FLAG		
SET?		
.	.	.
.Y	.N	.N
.	.	.
.	.	.
.	.	.
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.	.	.
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+01
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++
++489
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#10

#20

#30

第40

050

#60

028

80

768 V56/SKYLARK

FLAG, UTFLAG

• • •

RESTORE DAP DEADBAND
COMMAND ZERO VEHICLE
RATE

• • •

**IS HOLDFLAG
NEGATIVE?**

A scatter plot showing the relationship between variables Y and Z. The vertical axis is labeled Y and the horizontal axis is labeled Z. There are three data points plotted, showing a positive correlation. The points are approximately at (1, 1), (2, 2), and (3, 3).

SET HOLDFLAG ZERO

• • •

• • •

SET DAP REFERENCE
TO DESIRED DAP
CDUS

• • •

• • •

01

IS P20 THE PRESENT MAJOR MODE?

$$\begin{array}{c} \cdot \\ z \end{array} \quad \begin{array}{c} \cdot \\ y \end{array}$$
DO ROUTINE
R00

• • •

• • •

CONTINUE IN
PRESENT MAJOR

...

IS P20 IN THE MODE
LIGHTS?

2.

DO ROUTINE
R00

.....

CONTINUE IN
PRESENT MAJOR

...

V56 / SKYLARK

022

CHANGE CONTROL VOTES

REV 00 PCN 456
REV 01 PCN 489

F

REV 00 05/19/71

RESET STICK FLAG AND SET V50N18
FLAG EXTENDED VERB 58

PURPOSE: (1) RESET THE STICK FLAG (SEE P20 AND R61)
(2) SET THE V50N18 FLAG (SEE P20 AND R61)

ASSUMPTIONS: (1) PROCESS IS CREW INITIATED BY DSKY ENTRY

PROG CONT	CWC	GROUND	CREW
	START CREW INITIATED STICK FLAG RESET PROCESS	.	.CREW .SELECTION
	KEY IN V58E
	.	.	.

	.	.	.
	.	.	EXIT
	RESET STICK FLAG		
	.		
	.		
	SET V50N18 FLAG		
	.		
	.		
	...		
	.		
	.		
	EXIT		

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CHANGE CONTROL NOTES

ENABLE ALL JETS (DOCKED) EXTENDED
 VERB 59
 REV 00 05/19/71

PURPOSE: (1) TO ALLOW THE ASTRONAUT TO QUICKLY RE-ENABLE ALL JETS IN DOCKED DAP WHICH HAD BEEN INHIBITED VIA CHANNEL 5 JET INHIBIT AND CHANNEL 6 JET INHIBIT IN DOCKED DAP DATA LOAD.

ASSUMPTIONS: (1) THE PROCESS IS USED DURING CSM-OWS DOCKED CONFIGURATION.
 (2) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG CONT	CMC	GROUND	CREW
			.CREW .SELECTION
			.
			.
			...
			.
			.
			...
			EXIT

ENABLE ALL JETS IN CH5 AND CH6	KEY IN V59E
.	.
.	.
.	.
...	...
EXIT	EXIT

#10

CHANGE CONTROL NOTES

REV 00 PCR 005,040

CHANGE CONTROL NOTES

REV 01 03/20/72

SELECT MODE 1 (DISPLAY DAP ATTITUDE ERROR)
EXTENDED VFRB 61

++
+01
+489

PURPOSE: (1) TO DISPLAY ON THE FDI ERROR NEEDLES THE DIFFERENCE BETWEEN THE CURRENT CDU ANGLES AND THE DAP COMMANDED ANGLES.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THIS PROCESS MAY BE SELECTED AT ANY TIME.

PROG
CONT

CMC

GROUND

CREW

CREW
SELECTION

START CREW INITIATED
MODE 1 ERROR DISPLAY

KEY IN V61E

#10

RESET NEEDL FLG

#20

EXIT

EXIT

CHANGE CONTROL NOTES

REV 01 PCN 489

REV 01 03/20/72

SELECT MODE 2 (DISPLAY TOTAL ATTITUDE ERROR
(N22-N20)) EXTENDED VERB 52

++
+01
+489
++

PURPOSE:

(1) TO DISPLAY THE TOTAL ATTITUDE ERROR (N22-N20) ON THE FDI ATTITUDE ERROR NEEDLES.

ASSUMPTIONS:

(1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THIS PROCESS MAY BE SELECTED AT ANY TIME.

PROG
CONT

CMC

GROUND

CREW

CREW
SELECTION

.
. .
...

START CREW INITIATED
MODE 2 ERROR DISPLAY

KEY IN V62E

SET NEEDLFLG

.
.
.

SET N22JRN17
FLAG

.
.
.

EXIT

EXIT

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#10

#20

#30

CHANGE CONTROL NOTES

REV 01 PCN 489

784

V62/SKYLARK

884
V62/SKYLARK

CHANGE CONTROL NOTES

REV 01 PCN 483

786

V63/SKYLARK

V63/SKYLARK

REQUEST OPTICS ANGLES TRANSFORM ROUTINE (R64)
EXTENDED VERB 64

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED TO CALL ROUTINE
R64. SEE R64 FOR THE SPECIFICATION LOGIC FLOW.

CHANGE CONTROL NOTES

REV 00 PCR 040,405

REV 00 05/19/71

START OPTICAL VERIFICATION OF GYRO COMPASSING
(P03) EXTENDED VERB 65

NOTE: THIS EXTENDED VERB IS USED TO CALL PROGRAM
P03. SEE PROGRAM P23 FOR THE SPECIFICATION
LOGIC FLOW FOR STARTING THE OPTICAL
VERIFICATION OF GYRO COMPASSING.

CHANGE CONTROL NOTES

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TRANSFER THIS VEHIC-
LE STATE VECTOR TO
OTHER VEHICLE STATE
VECTOR

•
•
•
•••
•
EXIT

CHANGE CONTROL NOTES

REQUEST W-MATRIX RSS ERRJR DISPLAY EXTENDED VERB 67 REV 01 03/20/72

PURPOSE: (1) TO PROVIDE A MEANS OF DISPLAYING W-MATRIX INFORMATION AND LOADING NEW VALUES FOR REINITIALIZING THE W-MATRIX IF DESIRED.

ASSUMPTIONS: (1) NO OTHER EXTENDED VERBS ARE ACTIVE.

(2) THIS PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW

•CREW
•SELECTION
•
•
•

START W-MATRIX RSS
ERROR DISPLAY
PROCESS

KEY IN V67E

#10

IS ANOTHER EXTENDED
VERB, A MARKING DIS-
PLAY, OR A PRIORITY
DISPLAY ACTIVE?

.N .Y

TURN ON OPERATOR
ERROR LIGHT

#20

#30

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RESTART EXTENDED VERB 69 REV 01 03/20/72

PURPOSE:

(1) TO CAUSE A COMPUTER RESTART.

ASSUMPTIONS:

(1) THE RESTART IS CREW INITIATED BY DSKY ENTRY.

(2) V69E DOES NOT DIRECTLY SELECT RESTART PROCESSING. IT CAUSES A SITUATION WHICH SATISFIES ONE OF THE CONDITIONS FOR AN AUTOMATIC RESTART, I.E. TOO MANY CONSECUTIVE TC INSTRUCTIONS.

(3) THIS PROCESS MAY BE SELECTED AT ANY TIME.

PROG
CONT

CYC

GROUND

CREW

CREW
SELECTION

.
.
.
...

START CREW INITIATED
COMPUTER RESTART

KEY IN V69E

#10

++
+01
+
+
+
+489
++

BRANCH (TC) TO SELF

#20

NOTE: THE LOGIC FROM
THIS POINT IS NOT

#30

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\$50

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02春

080

862

V69/SKYLARK

ON?

.Y .N

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C

#90

#100

#110

#120

HAVE BOTH THE
MARK REJECT
AND ERROR RE-
SET BUTTONS
BEEN PRESSED?

.Y .N

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WAS ERASABLE
MEMORY CHECK
IN PROCESS
WHEN THE
RESTART
OCCURRED?

.Y .N

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DO CONTROL REG-
ISTERS HAVE DEF-
ICIENT DATA?

.Y .N

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#130

#140

#150

091#

#170

#180

V69/SKYLARK

800

++
+01
+
+
+489
++

BLANK DSKY REGISTERS
(PROGRAM, VERB,
NOUN, R1, R2, R3)
.....
OBSERVE DSKY
REGISTERS BLANK

#190

RESET DISPLAY/ASTRO-
NAUT INTERFACE FLAGS

.....

A.J DO CONTROL REGI-
STERS HAVE DEFICIENT
DATA?
B.J HAVE BOTH MARK
REJECT AND ERROR RE-
SET BUTTONS BEEN
PRESSED?
C.J WAS AGC WARNING
LIGHT TURNED ON
WITHOUT OSCILLATOR
FAIL?

#200

.....
ANY ALL.
YES NO.
.....
GO TO
"B"
BELOW

#210

.....
CLEAR SELF CHECK
ERROR REGISTERS,
.....

#220

MODE REGISTER.

.
.

ZERO OUTBIT
CHANNELS: 11
{*A" RELAYS); 12
(GNC) (BITS 6 AND
4 SET TO 1 IF
NECESSARY); 13
(AGC); AND
14 (ISS)

.
.

INITIALIZE DOWN-
LINK WITH P00
DOWNLIST

.
.

CLEAR PHASE TABLE

.
.

INITIALIZE IMU
(INHIBIT IMU FAIL
FOR APPROXIMATELY
7.90 SECONDS)

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TERMINATE OPTICS
COARSE ALIGN

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#230

#240

#250

#260

#270

#280

++
+01
+
+
+489
++

TURN OFF DSKY DIS-
CRETE LIGHTS EXCEPT
PROG, GIMBAL LOCK
AND NO ATT.

.....

UBSERVE DSKY
LIGHTS OFF EXCEPT
PROG, GIMBAL LOCK
AND NO ATT

#340

IS NO ATT LIGHT ON?

.N
.Y
.Y
.Y

RETURN ISS TO
COARSE ALIGN

#350

IS ENGONFLG SET?

.N
.Y
.Y
.Y

#360

TURN ENGINE ON
(BIT 13 CHANNEL
11)

TEST PHASE TABLE.
IS IT CORRECT?

.N
.Y
.Y
.Y

#370

TURN ON PROG
ALARM AND

805

913
V69/SKYLARK

STORE ALARM
CODE 1107

#380

WERE ANY PHASES
ACTIVE?

#390

DO ROUTINE
R00

#400

DISPLAY PROGRAM
NUMBER

#410

EXIT EXIT

CHANGE CONTROL NOTES

REV 01 PCN 489

V59/SKYLARK

REV 00 05/19/71

UPDATE LIFTOFF TIME (P27) EXTENDED VER3 70

NOTE: THIS EXTENDED VER3 IS USED BY UPDATE PROGRAM
P27 ONLY. SEE P27 FOR THE SPECIFICATION LOGIC
FLOW FOR UPDATING THE LIFTOFF TIME.

CHANGE CONTROL NOTES

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UNIVERSAL UPDATE - BLOCK ADR (P27)
EXTENDED VERB 71
REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED BY UPDATE PROGRAM
P27 ONLY. SEE P27 FOR THE SPECIFICATION LOGIC
FLOW FOR A BLOCK ADDRESS UNIVERSAL UPDATE.

CHANGE CONTROL NOTES

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UNIVERSAL UPDATE - SINGLE ADDRESS (P27)
EXTENDED VERB 72

REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED WITH UPDATE
PROGRAM P27 ONLY. SEE P27 FOR THE SPECIFI-
CATION LOGIC FLOW FOR A SINGLE
ADDRESS UNIVERSAL UPDATE.

CHANGE CONTROL NOTES

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UPDATE CMC TIME (OCTAL) (P27)
EXTENDED VERB 73
REV 00 05/19/71

NOTE: THIS EXTENDED VERB IS USED BY THE UPDATE
PROGRAM P27 ONLY. SEE P27 FOR THE SPECIFI-
CATION LOGIC FLOW FOR THE OCTAL UPDATE OF
CMC TIME.

CHANGE CONTROL NOTES

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INITIALIZE ERASABLE DUMP VIA DOWNLINK
EXTENDED VERB 74

REV 00 05/19/71

PURPOSE:

(1) TO DUMP ALL EIGHT BANKS OF ERASABLE MEMORY VIA DOWNLINK.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

(2) THE DUMP OF EACH BANK IS PRECEDED BY AN ID WORD, SYNC BITS, ECADR AND TIME.

(3) THE E BANKS ARE DUMPED IN ORDER, STARTING WITH E BANK ZERO.

(4) DUMPING OF ALL EIGHT BANKS IS REPEATED ONCE (TWO COMPLETE DUMPS) TO FACILITATE SUCCESSFUL GROUND RECORDING.

(5) THE TIME REQUIRED FOR 2 COMPLETE DUMPS IS 41.6 SECONDS (100 WORDS PER SEC BIT RATE).

PROG
CONT

CMC

GROUND

CREW

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CREW
SELECTION

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.
.
...

START CREW INITIATED
DOWNLINK ERASABLE
DUMP

KEY IN V74E

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.
.

TERMINATE CURRENT
DOWNLIST

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.
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.

#10

#20

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#30

SET E BANK COUNTER,
WORD COUNTER, AND
DUMP COUNTER=0

#40

INITIALIZE E BANK
DUMP. DUMP ID, SYNCH
BITS, ECADR AND
TIMEL.

#50

DUMP E BANK

#60

INCREMENT E BANK
COUNTER AND SET WORD
COUNTER=0.

#70

ARE ALL 8 BANKS
DUMPED (E BANK
COUNTER = 8)?

.N .Y

INCREMENT DUMP COU-
NTER AND SET E BANK

SET LIFTOFF FLAG EXTENDED VERB 75

PURPOSE: (1) SET LIFTOFF BACKUP FLAG.

ASSUMPTIONS: (1) THE PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW

• CREW
• SELECTION

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```

-----
START CREW INITIATED ..... KEY IN V75E
SET LIFTOFF FLAG .....
PROCESS .....

```

```

EXIT
  .
  .
  .

```

SET LIFTOFF BACKUP
FLAG

EXIT

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#10

#20

#30

CHANGE CONTROL NOTES

ENABLE RANGE RATE MARK PROCESSING
ROUTINE (R27) EXTENDED VERB 76

REF 01 03/20/72

PURPOSE:

- ++ (1) TO ENABLE THE RANGE RATE MARK PROCESSING ROUTINE R27 TO BE CALLED FROM R22.
- ++ #01 (2) TO ALLOW THE ASTRONAUT TO SELECT A SEQUENCE OF TIMES FOR WHICH THE RANGE RATE WILL BE OPTIMIZED.
- ++ #459 (3) TO PROVIDE A MEANS OF REINITIALIZING THE RANGE RATE FILTER.
- ++

ASSUMPTIONS:

- ++ (1) THE RANGE RATE FILTER WILL REQUIRE APPROXIMATELY 120 SECONDS TO CONVERGE TO THE DESIRED ACCURACY.
- ++ #01 (2) IF THE ASTRONAUT LOADS N72 WITH A TIME IN THE FUTURE, OPTIMIZATIONS WILL OCCUR AUTOMATICALLY EVERY 4 MINUTES, BEGINNING WITH THAT TIME (V72) SELECTED BY THE ASTRONAUT.
- ++ (3) THIS PROCESS MAY BE CREW SELECTED BY DSKY ENTRY AT ANY TIME PRIOR TO FIRST USE OF R27 DURING P20. IT IS NOT NECESSARY TO SELECT V76E AGAIN DURING THE RENDEZVOUS UNLESS R27 HAS BEEN DISABLED VIA V77E.
- ++

PROG
CONT

CREW

GROUND

CMC

CREW
SELECTION

#10

START CREW INITIATED KEY IN V76E
EXTENDED VERB 76
PROCESS

IS ANOTHER EXTENDED
VERB A MARKING DIS-
PLAY, OR A PRIORITY

#20

DISPLAY ACTIVE?

Y. .N

TURN ON OPERATOR
ERROR LIGHT

.
.
.
...
EXIT

HOLD . FLASH VERB-NOUN TO
..... REQUEST RESPONSE AND
SNAP . DISPLAY TIME OF
OPTIMIZATION:
V06 N72
R1 - R27 OPT-HRS
R2 - R27 OPT-MIN
R3 - R27 OPT-SEC

R27 OPT -
TIME FOR WHICH RANGE
RATE WILL BE OPTI-
MIZED TO NEAREST
.01 SEC.
(ZEROS INDICATE NO
OPTIMIZATION DESIRED)

WAIT FOR KEYBOARD
ENTRY

MONITOR DSKY:
OBSERVE VERB-NOUN
FLASH TO REQUEST
RESPONSE AND DISPLAY
OF TIME OF OPTIMI-
ZATION.

AM I SATISFIED WITH
THE DISPLAYED TIME?

Y. .N

KEY IN PROCEED

EXIT

#30

#40

#50

#60

#70

08卷

#90

第100

#110

```

RESET R27UP1 FLAG
.
.
.

RESET R27UP2 FLAG
.
.
.

SET R27FLAG
.
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.
...
.
EXIT

```

CHANGE CONTROL VOTES

REV 00 PCR 439
REV 01 PCR 459

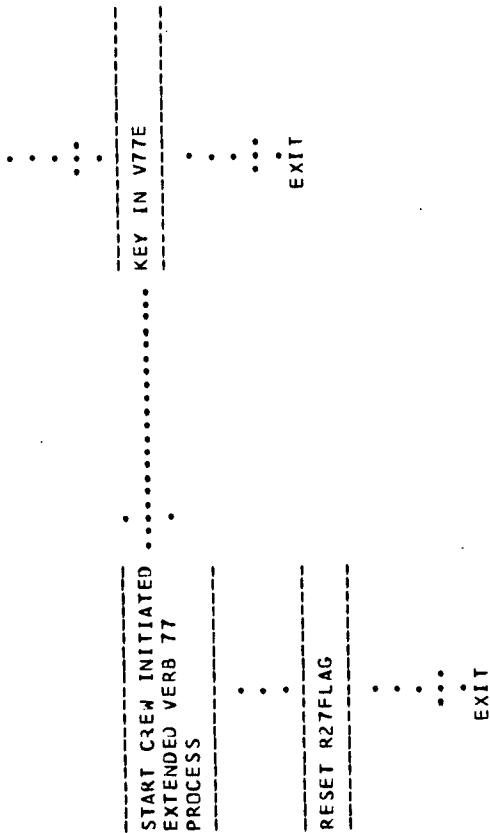
DISABLE VHF RANGE RATE MARK PROCESSING
 ROUTINE (R27) EXTENDED VERB 77
 REV 00 05/19/71

- PURPOSE: (1) TO TERMINATE OPERATION OF THE RANGE RATE MARK PROCESSING ROUTINE R27 IN R22.
- ASSUMPTIONS: (1) R27 MAY ONLY BE CALLED AGAIN FROM R22 VIA V76E, WHICH WILL REINITIALIZE R27.
- (2) THIS PROCESS MAY BE CREW SELECTED BY DSKY ENTRY AT ANY TIME.

PROG
 CONT

CMC GROUND CREW

CREW
 SELECTION



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CHANGE CONTROL NOTES

REV 00 PCR 439

829

939
V78/SKYLARK

TERMINATE FLASH UPON
RECEIPT OF PROCEED
OR NEW DATA

P	NEW
R	DATA
O	.
C	.
E	-----
E	STORE NEW
D	DATA

EXIT

CHANGE CONTROL VOTES

LOAD NEW LAUNCH
AZIMUTH

EXIT

06#

#100

V78/SKYLARK

UPDATE OWS STATE VECTOR EXTENDED VERB 80 REV 00 05/19/71

PURPOSE: (1) TO CAUSE THE RENDEZVOUS DATA PROCESSING RESULTS TO UPDATE THE OWS STATE VECTOR.
ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG
CONT

CMC

GROUND

CREW

.CREW
.SELECTION
.
.
.
.

START CREW INITIATED
OWS STATE VECTOR UP-
DATE PROCESS

KEY IN V80E

.
.
.
.
.

.
.
.
.
.
EXIT

RESET VEHICLE UPDATE
FLAG

.
.
.
.
EXIT

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CHANGE CONTROL NOTES

#10

#20

#30

UPDATE CSM STATE VECTOR EXTENDED VER3 81

PURPOSE: (1) TO CAUSE THE RENDEZVOUS DATA PROCESSING RESULTS TO UPDATE THE CSM STATE VECTOR.

ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG
CONT

CYC

GROUND

CREW

• CREW
• SELECTION

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START CREW INITIATED
CSM STATE VECTOR
UPDATE PROCESS

KEY IN V81E

EXIT

SET VEHICLE UPDATE
FLAG

EXIT

CHANGE CONTROL NOTES

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第20

#30

REQUEST ORBITAL PARAMETERS DISPLAY (R30)
EXTENDED VERB 82

REV 00 05/19/71

NOTE: THIS EXTENDED VERB CALLS ROUTINE 33. SEE
R30 FOR THE SPECIFICATION LOGIC FLOW FOR
REQUESTING ORBITAL PARAMETERS DISPLAY.

CHANGE CONTROL NOTES

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REV 00 05/19/71

REQUEST RENDEZVOUS PARAMETER
DISPLAY #1 (R31) EXTENDED VERB 83

NOTE: THIS EXTENDED VER3 CALLS ROUTINE 31. SEE
R31 FOR THE SPECIFICATION LOGIC FLOW FOR
REQUESTING RENDEZVOUS PARAMETER DISPLAY #1

CHANGE CONTROL NOTES

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REV 00 05/19/71

REQUEST RENDEZVOUS PARAMETER
DISPLAY #2 (R34) EXTENDED VERB 85

NOTE: THIS EXTENDED VER3 CALLS ROUTINE 34. SEE
R34 FOR THE SPECIFICATION LOGIC FLJW FOR
REQUESTING RENDEZVOUS PARAMETER DISPLAY #2.

CHANGE CONTROL NOTES

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REV 00 05/19/71

REJECT RENDEZVOUS BACKUP SIGHTING
MARK EXTENDED VERB 86

PURPOSE: (1) IN THE EVENT OF AN UNSATISFACTORY SIGHTING MARK TAKEN DURING THE RENDEZVOUS BACKUP SIGHTING MARK ROUTINE (R23),
V86E MAY BE USED TO ERASE THE MARK DATA (IF ANY) IN POSITION 1.

ASSUMPTIONS: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.

PROG
CONT

C4C

GROUND

CREW

.CREW
.SELECTION

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START CREW INITIATED
REJECT OF RENDEZVOUS
BACKUP SIGHTING
MARK PRJCESS.

KEY IN V86E

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.
EXIT

ERASE MARK DATA
(IF ANY) IN POSITION
#1 OR SET REJCTFLG
TO REJECT MARK BEING
PROCESSED BY R22
(IF ANY)

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RECYCLE TO PERFORM
ALTERNATE LOS

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#30

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CHANGE CONTROL VOTES

REV 00 PCN 457

842

REV 00 05/19/71

SET VHF RANGE FLAG EXTENDED VERB 87

PURPOSE: (1) TO SET THE VHF RANGE FLAG
 ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY

PROG CONT	CMC	GROUND	CREW	
				.CREW .SELECTION
				.
				...
				.
				KEY IN V87E
				.
				.
				...
				EXIT

#10

#20

#30

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CHANGE CONTROL NOTES

RESET VHF RANGE FLAG EXTENDED VERB 88

PURPOSE: (1) TO RESET THE VHF RANGE FLAG.

ASSUMPTION: (1) PROCESS IS CREW SELECTED BY DSKY ENTRY.

CMC

CREW SELECTION

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INITIATE RESET VHF
RANGE FLAG PROCESS

• • • • •

TURN OFF TRACKER
LIGHT

• • •

RESET VHF
RANGE FLAG

• • • • •

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第10卷

#20

#30

CHANGE CONTROL NOTES

958
V88/SKYLARK

846

V88/SKYLARK

START RENDEZVOUS FINAL ATTITUDE (R63)
EXTENDED VERB 89

REV 00 05/19/71

NOTE: THIS EXTENDED VERB CALLS ROUTINE 63. SEE
R63 FOR THE SPECIFICATION LOGIC FLOW TO START
RENDEZVOUS FINAL ATTITUDE MANEUVER.

CHANGE CONTROL NOTES

REV 00 05/19/71

REQUEST RENDEZVOUS OUT-OF-PLANE DISPLAY (R36)
EXTENDED VERB 90

NOTE: THIS EXTENDED VER3 CALLS ROUTINE 36. SEE
R36 FOR THE SPECIFICATION LOGIC FLOW OF THE
REQUEST FOR RENDEZVOUS OUT-OF-PLANE DISPLAY.

CHANGE CONTROL NOTES

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REV 01 03/20/72

REQUEST BANKSUM DISPLAY
EXTENDED VERB 91

- PURPOSE: (1) DISPLAY THE SUM OF EACH BANK FOR COMPARISON.
- ASSUMPTIONS: (1) PJO IS OPERATING.
- (2) NO OTHER EXTENDED VERB IS ACTIVE.
- (3) PROCESS IS CREW SELECTED BY DSKY ENTRY

PROG CONT	CMC	GROJND	CREW
++			.CREW
+01			.SELECTION
+			.
+			.
+489			...
++			.
	START CREW INITIATED	KEY IN V91E	
	BANKSUM DISPLAY		
	.		
	.		
	.		
	IS PROGRAM P00		
	OPERATING?		
	.Y		
	.N		
	.		
	.		
	.		
	.		
	IS ANOTHER		
	EXTENDED		
	VERB, A		
	MARKING		
	DISPLAY,		

#10

#20

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#30

#40

#50

#60

#70

OR A PRIOR-
RITY DIS-
PLAY
ACTIVE?

.N .Y

TURN ON OPERA-
TOR ERROR LIGHT

EXIT

INITIALIZE ROUTINE
TO DISPLAY BANK SUMS

FLASH V-N TO REQUEST
DISPLAY OF BANK SUM
V05 V01
R1 BANK SUM
R2 BANK #
R3 BUGGER WORD

BANK SUM-SUM OF THE
BITS OF THE CHOSEN
BANK
BANK # - NUMBER OF
BANK BEING READ.
BUGGER WORD-FACTOR
REQUIRED TO MAKE
|R1| = |R2|.

MONITOR DSKY:
OBSERVE V-N FLASH TO
REQUEST DISPLAY OF
BANK SUMS

IS THIS THE BANK I
DESIRE TO READ?

.N .Y

IS THE BANK SUM
THE NUMBER I EX-

08*

067

001#

0110

#120

V91/SKYLARK

.
.
.
.
.
.

INCREMENT
BANK
NUMBER.

.
.
.
.....

968
V91/SKYLARK

#130

#140

CHANGE CONTROL NOTES

REV 01 PCN 489

854

V91/SKYLARK

TERMINATE INTEGRATION AND GO TO P00
EXTENDED VERB 96

REV 01 03/20/72

PURPOSE: (1) TO PROVIDE A MEANS OF SUSPENDING STATE VECTOR INTEGRATION.

ASSUMPTIONS: (1) IF THE COASTING INTEGRATION ROUTINE IS IN OPERATION, IT IS TERMINATED AT THE END OF THE CURRENT TIME STEP.

(2) THE CURRENT PROGRAM IS TERMINATED

(3) THE CMC IDLING PROGRAM IS ACTIVATED.

(4) NO STATE VECTOR INTEGRATION OCCURS UNTIL THE RESELECTION OF ANY PROGRAM OR EXTENDED VERB. NO P00 INTEGRATION OCCURS UNTIL THE RESELECTION OF P00.

(5) THIS ROUTINE DOES NOT MAINTAIN STATE VECTOR OR W-MATRIX SYNCHRONIZATION.

(6) RESELECTION OF A NEW PROGRAM WILL REINITIALIZE THE NORMAL TIMING OF STATE VECTOR INTEGRATION.

PROG
CONT

CMC GROUND CREW

CREW
SELECTION

++
+01
+
+
+
+489
++

START TERMINATE
INTEGRATION AND GO
TO P00 PROCESS

KEY IN V96E

SET QUIT FLAG

GO TO
R00

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#10

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#20

SET V96UNFLG

GO TO IDLING PROGRAM
(P00) VIA ROUTINE
R00

GO TO "A"
IN ROOM

040

CHANGE CONTROL VOTES

REV 01 PCN 489

858 V96/SKYLARK

THRUST FAIL DISPLAY EXTENDED VERB 97

REV 00 05/19/71

NOTE: EXTENDED VERB 97 IS USED IN THE SPS THRUST FAIL ROUTINE R40. SEE R40 FOR THE SPECIFICATION LOGIC FLOW FOR DISPLAY OF THRUST FAIL.

THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD NOT BE SELECTED BY THE CREW.

CHANGE CONTROL NOTES

ENABLE ENGINE IGNITION EXTENDED
VERB 99

REV 00 05/19/71

NOTE: EXTENDED VERB 99 IS USED IN THE SPS PROGRAM P40. SEE
P40 FOR THE SPECIFICATION LOGIC FLOW TO ENABLE ENGINE IGNITION.

THIS VERB IS INTERNALLY INITIATED BY THE PROGRAM AND SHOULD
NOT BE SELECTED BY THE CREW.

CHANGE CONTROL NOTES

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REV 01 03/20/72

PCR/PCN

4.5 THIS LIST REPRESENTS THE VERBS USED IN PROGRAM SKYLARK

4.5.1 REGULAR VERBS

- 00 NOT IN USE
- 01 DISPLAY OCTAL COMP 1 IN R1
- 02 DISPLAY OCTAL COMP 2 IN R1
- 03 DISPLAY OCTAL COMP 3 IN R1
- 04 DISPLAY OCTAL COMP 1,2 IN R1,R2
- 05 DISPLAY OCTAL COMP 1,2,3 IN R1,R2,R3
- 06 DISPLAY DECIMAL IN R1 OR R1,R2 OR R1,R2,R3
- 07 DISPLAY DP DECIMAL IN R1,R2
- 08 SPARE
- 09 SPARE
- 10 SPARE
- 11 MONITOR OCTAL COMP 1 IN R1
- 12 MONITOR OCTAL COMP 2 IN R1
- 13 MONITOR OCTAL COMP 3 IN R1
- 14 MONITOR OCTAL COMP 1,2 IN R1,R2
- 15 MONITOR OCTAL COMP 1,2,3 IN R1,R2,R3
- 16 MONITOR DECIMAL IN R1 OR R1,R2 OR R1,R2,R3
- 17 MONITOR DP DECIMAL IN R1,R2
- 18 SPARE
- 19 SPARE
- 20 SPARE
- 21 LOAD COMPONENT 1 INTO R1
- 22 LOAD COMPONENT 2 INTO R2
- 23 LOAD COMPONENT 3 INTO R3

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24 LOAD COMPONENT 1,2 INTO R1,R2
 25 LOAD COMPONENT 1,2,3 INTO R1,R2,R3
 26 SPARE
 27 DISPLAY FIXED MEMORY

 28 SPARE
 29 SPARE
 30 REQUEST EXECUTIVE
 31 REQUEST WAITLIST
 32 RECYCLE
 33 PROCEED
 34 TERMINATE
 35 TEST DSKY LIGHTS
 36 REQUEST FRESH START
 37 CHANGE PROGRAM
 38 SPARE
 39 SPARE

 4.5.2 EXTENDED VERBS

 40 ZERO IMU CDU
 41 COARSE ALIGN CDU (W N20,N91)
 42 PULSE TORQUE GYRO
 43 LOAD FDAI ATT ERROR NEEDLES (TEST ONLY)
 44 REQUEST DOCKED DAP DATA LOAD (R04)
 45 ACTIVATE DUCKED DAP
 46 ACTIVATE CSM DAP
 47 SET OMS STATE VECTOR INTO CSM STATE VECTOR
 48 REQUEST CSM DAP DATA LOAD (R03)
 49 START C 4-DEFINED MANEUVER (R62)

50 PLEASE PERFORM
51 PLEASE MARK
52 SPARE
53 PLEASE MARK ALTERNATE LOS
54 START RENDEZVOUS BACKUP SIGHTING MARK (R23)
55 INCREMENT CMC TIME (DECIMAL)
56 TERMINATE TRACKING
57 SPECIFY SETTING OF FULL TRACK FLAG
58 RESET STICK FLAG AND SET V50N18 FLAG
59 ENABLE ALL JETS (DOCKED)
60 SET ATTITUDE ERROR REFERENCE TO PRESENT ATTITUDE
61 SELECT MODE 1 (DISPLAY DAP ATTITUDE ERROR)
62 SELECT MODE 2 (DISPLAY TOTAL ATTITUDE ERROR (N22-N20))
63 SELECT MODE 3 (DISPLAY TOTAL ASTRONAUT ATTITUDE ERROR (N17-N20))
64 REQUEST OPTICS ANGLES TRANSFORM (R64)
65 START OPTICAL VERIFICATION OF GYRO COMPASSING (P03)
66 SET CSM STATE VECTOR INTO OMS STATE VECTOR
67 REQUEST W-MATRIX RSS ERROR DISPLAY
68 SPARE
69 RESTART
70 UPDATE LIFTOFF TIME (P27)
71 UNIVERSAL UPDATE-BLOCK ADR (P27)
72 UNIVERSAL UPDATE-SINGLE ADR (P27)
73 UPDATE CMC TIME (OCTAL) (P27)
74 INITIALIZE ERASABLE DUMP VIA DOWNLINK
75 SET LIFTOFF FLAG
76 ENABLE RANGE RATE MARK PROCESSING (R27)
77 DISABLE RANGE RATE MARK PROCESSING (R27)

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489

- 78 CHANGE GYRO COMPASS LAUNCH AZIMUTH
- 79 SPARE
- 80 UPDATE OMS STATE VECTOR
- 81 UPDATE CSM STATE VECTOR
- 82 REQUEST ORBITAL PARAMETERS DISPLAY (R30)
- 83 REQUEST RENDEZVOUS PARAMETER DISPLAY #1 (R31)
- 84 SPARE
- 85 REQUEST RENDEZVOUS PARAMETER DISPLAY #2 (R34)
- 86 REJECT RENDEZVOUS BACKUP SIGHTING MARK
- 87 SET VHF RANGE FLAG
- 88 RESET VHF RANGE FLAG
- 89 START RENDEZVOUS FINAL ATTITUDE (R63)
- 90 REQUEST RENDEZVOUS OUT-OF-PLANE DISPLAY (R36)
- 91 REQUEST BANKSUM DISPLAY
- 92 SPARE
- 93 ENABLE W-MATRIX INITIALIZATION
- 94 SPARE
- 95 SPARE
- 96 TERMINATE INTEGRATION AND GO TO P00
- 97 THRUST FAIL DISPLAY
- 98 SPARE
- 99 ENABLE ENGINE IGNITION

CHANGE CONTROL NOTES

REV 00 PCR 004,005,006,007,010,040,405,439, PCN 457
REV 01 PCN 489

REV 01 03/20/72 PCR/PCN

489

4.6 THIS LIST REPRESENTS THE NJUNS USED IN PROGRAM SKYLARK.

NJUNS SPECIFIED AS NOT BEING LOADABLE ARE MARKED (NL).

00 NOT IN USE

01 SPECIFY ADDRESS (FRAC)

.XXXX FRAC
.XXXX FRAC
.XXXX FRAC

02 SPECIFY ADDRESS (WHOLE)

XXXX. INTEG
XXXX. INTEG
XXXX. INTEG

03 SPECIFY ADDRESS (DEGREE)

XXX.XX DEG
XXX.XX DEG
XXX.XX DEG

04 ATTITUDE ERROR (NL)

R XXX.XX DEG
P XXX.XX DEG
Y XXX.XX DEG

05 ANGULAR ERROR/DIFFERENCE
SIGHTING ANGLE

XXX.XX DEG
XXX.XX DEG

06 OPTION CODE

OCT
OCT

07 CHANNEL/FLAGWORD/ERASABLE OPERATOR

OCT
OCT
OCT
OCT

08 ALARM DATA

OCT
OCT
OCT

09 ALARM CODES

OCT
OCT
OCT

10 CHANNEL TO BE SPECIFIED

OCT

11 TIG (NCC)

00XXX. HRS
000XX. MIN
0XX.XX SEC

12 OPTION CODE

OCT
OCT

13 TIG (NSR)

00XXX. HRS

14	STAR TRACKER AZIMUTH ELEVATION	0000. MIN 000. XX SEC
15	INCREMENT ADDRESS	XXXX. ARC MIN XXXX. ARC MIN OCT
16	TIME OF EVENT (USED BY EXT VERB ON_Y)	0000. HRS 0000. MIN 000. XX SEC
17	ASTRONAUT TOTAL ATTITUDE (USED IN MODE 3 NEEDLES (V63))	R XXX. XX DEG P XXX. XX DEG Y XXX. XX DEG
18	BALL ANGLES AUTO MANEUVER	R XXX. XX DEG P XXX. XX DEG Y XXX. XX DEG
19	STAR TRACKER AZIMUTH	OCT OCT
20	PRESENT ICDU ANGLES	R XXX. XX DEG P XXX. XX DEG Y XXX. XX DEG
21	PIPAS	X XXXX. PULSES Y XXXX. PULSES Z XXXX. PULSES
22	NEW ICDU ANGLES	R XXX. XX DEG P XXX. XX DEG Y XXX. XX DEG
23	NAV BASE TO ATM DOCKING ANGLES	ALPHA BETA GAMMA XXX. XX DEG XXX. XX DEG XXX. XX DEG
24	DELTA TIME FOR CMC CLOCK	0000. HRS 0000. MIN 000. XX SEC
25	CHECKLIST (USED WITH V50)	XXXX.
26	PRIO/DELAY, ADRES, BBCCN	OCT OCT OCT
27	SELF TEST ON/OFF SWITCH	XXXX.
28	TIG (NC2)	0000. HRS 0000. MIN 000. XX SEC
29	XSM LAUNCH AZ	XXX. XX DEG

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30	TARGET CODE (GYROCOMPASSING VERIFICATION)	XXXXX. XXXXX. XXXXX.
31	TIME OF LAST 4-MATRIX REINITIALIZATION	0000X. HRS 0000X. MIN 00X.XX SEC
32	TIME FROM PERIGEE	0000X. HRS 0000X. MIN 00X.XX SEC
33	TIG	0000X. HRS 0000X. MIN 00X.XX SEC
34	TIME OF EVENT	0000X. HRS 0000X. MIN 00X.XX SEC
35	TIME FROM EVENT	0000X. HRS 0000X. MIN 00X.XX SEC
36	TIME OF CMC CLOCK	0000X. HRS 0000X. MIN 00X.XX SEC
37	TIG (TPI)	0000X. HRS 0000X. MIN 00X.XX SEC
38	TIME OF STATE VECTOR	0000X. HRS 0000X. MIN 00X.XX SEC
39	TIG OF LAST MANEUVER	0000X. HRS 0000X. MIN 00X.XX SEC
40	TFI/TCF (NL) VG DELTA V (ACCUMULATED)	XXBXX M-S XXXX.X FPS XXXX.X FPS
41	TARGET AZIMUTH TARGET ELEVATION TARGET IDENTIFIER (OCTAL PASTE FROM N30)	XXX.XX DEG XX.XXX DEG 0000X
42	APD ALT PER ALT DELTA V (REQUIRED)	XXXX.X NM XXXX.X NM XXXX.X FPS
43	LATITUDE (+ NORTH) LONGITUDE (+ EAST) ALTITUDE	XXX.XX DEG XXX.XX DEG XXXX.X NM

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XXXX.X NM
XXXX.X NM
XXBXX M-S

44 APO ALT (NL)
PER ALT
TFF

489

XXBXX
XXBXX M-S
XXX.XX DEG
/0000X.

45 MARKS (VHF-OPTICS) (NL)
TFI (NEXT BURN)
MGA/CODE

46 DAP CONFIG
OCT
OCT

47 THIS VEHICLE WEIGHT
OTHER VEHICLE WEIGHT
XXXXX. LBS
XXXXX. LBS

48 GIMBAL PITCH TRIM
GIMBAL YAW TRIM
XXX.XX DEG
XXX.XX DEG

49 DELTA R
DELTA V
SOURCE CODE
XXX.XX NM
XXXXX.X FPS
0000X.

489

XXXXX.X NM
XXXXX.X NM
XXBXX M-S

50 SPLERROR (NL)
PERIGEE
TFF

51 SPARE

52 CENTRAL ANGLE OF ACTIVE VEHICLE

XXX.XX DEG

53 RANGE
RANGE RATE
PHI

XXX.XX NM
XXXXX.X FPS
XXX.XX DEG

54 RANGE
RANGE RATE
THETA

XXX.XX NM
XXXXX.X FPS
XXX.XX DEG

55 NN
ELEVATION ANGLE (E)

XXXXX.
XXX.XX DEG

56 VEHICLE RATE (NL)

R X.XXXX DEG/SEC
P X.XXXX DEG/SEC
Y X.XXXX DEG/SEC

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57 HALFREVS
DELTA H (NCC)
DELTA H (NSR)

XXXXX.
XXXXX.X NM
XXXXX.X NM

489

58 DELTA V (TPI)
DELTA V (TPF)
DELTA T (TPI-VOMTPI)

XXXXX.X FPS
XXXXX.X FPS
XXBXX M-S

489

59 DELTA V LOS 1
DELTA V LOS 2
DELTA V LOS 3

XXXXX.X FPS
XXXXX.X FPS
XXXXX.X FPS

870

50	G MAX VPRED GAMMA EI (+ UP)	XXX.XX G XXXXX. FPS XXX.XX DEG	
61	IMPACT LATITUDE IMPACT LONGITUDE HEADS UP/DOWN (+ UP)	XXX.XX DEG XXX.XX DEG +/- 00001.	489
62	VI , INERTIAL VEL MAG HDOT , ALT RATE H , ALT ABOVE PAD RADIUS	XXXXX. FPS XXXXX. FPS XXXXX.X NM	
63	RTOGO , RNG FROM E.I. TO SPLASH (NL) VIO , PREDICTED INERT VEL AT E.I. TFE , TIME FROM FROM E.I.	XXXXX.X NM XXXXX. FPS XXBXX M-S	489
64	G , DRAG ACCELERATION VI , INERTIAL VELOCITY R TO GO (+ OVSHT)	XXX.XX G XXXXX. FPS XXXXX.X NM	
65	SAMPLED CMC TIME (FETCHED IN INTERRUPT)	0000X. HRS 0000X. MIN 0XX.XX SEC	
66	BETA, CMD BANK ANGLE CROSS RANGE ERROR (+ TGT RT) DCWN RANGE ERROR (+ OVSHT)	XXX.XX DEG XXXXX.X NM XXXXX.X NM	
67	R TO GO (+ OVSHT) LAT , PRESENT POSITION (+ NORTH) LONG , PRESENT POSITION (+ EAST)	XXXXX.X NM XXX.XX DEG XXX.XX DEG	
68	BETA, CMD BANK ANGLE VI , INERTIAL VELOCITY HDOT , ALT RATE	XXX.XX DEG XXXXX. FPS XXXXX. FPS	
69	BETA DL VL	XXX.XX DEG XXX.XX G XXXXX. FPS	
70	SIGHTING SOURCE - CELESTIAL BODY CCDE (BEFORE MARK)	OCT	
71	SIGHTING SOURCE - CELESTIAL BODY CCDE (AFTER MARK)	OCT	
72	TIME OF R27 OPTIMIZATION	0000X. HRS 0000X. MIN 0XX.XX SEC	
73	ALTITUDE VELOCITY FLIGHT PATH ANGLE	XXXXXB. NM XXXXX. FPS XXX.XX DEG	
74	BETA, CMD BANK ANGLE VI , INERTIAL VELOCITY	XXX.XX DEG XXXXX. FPS	

75	G + DRAG ACCELERATION	XXX.XX G	489
	DELTA H (NSR) (NL)	XXXX.X NM	
	DELTA T (TPI-JSR)	XXBXX MIN/SEC	
	DELTA T (TPI-NOMTPI)	XXBXX MIN-SEC	
76	R27 RANGE RATE (NL)	XXX.XX NM	489
	R27 RANGE RATE	XXXX.X FPS	
	TIME FROM R27 OPTIM	XXBXX M-S	
77	R27 RANGE RATE	XXX.XX NM	489
	R27 RANGE RATE	XXXX.X FPS	
	R27 THETA/PHI/CODE	XXX.XX DEG	
		/-00001	
78	GAMMA	XXX.XX DEG	
	RHO	XXX.XX DEG	
	CMICRON	XXX.XX DEG	
79	RATE (+ INCREASING CDU) DEADBAND	X.XXXX DEG/SEC	489
		XXX.XX DEG	
80	TFI/TFC (NL)	XXBXX M-S	
	VG	XXXXX. FPS	
	DELTA V (ACCUMULATED)	XXXXX. FPS	
81	DELTA VX (LV)	XXXX.X FPS	
	DELTA VY (LV)	XXXX.X FPS	
	DELTA VZ (LV)	XXXX.X FPS	
82	DELTA VX (LV) FOR NSR	XXXX.X FPS	
	DELTA VY (LV) FOR NSR	XXXX.X FPS	
	DELTA VZ (LV) FOR NSR	XXXX.X FPS	
83	DELTA VX (CONT)	XXXX.X FPS	
	DELTA VY (CONT)	XXXX.X FPS	
	DELTA VZ (CONT)	XXXX.X FPS	
84	DELTA V (NEXT MANEUVER)	XXXX.X FPS	
	DELTA H (NEXT MANEUVER)	XXXX.X NM	
	DELTA V (THIRD MANEUVER)	XXXX.X FPS	
85	VGX (CONT)	XXXX.X FPS	489
	VGY (CONT)	XXXX.X FPS	
	VGZ (CONT)	XXXX.X FPS	
86	DELTA VX (LV)	XXXX.X FPS	
	DELTA VY (LV)	XXXX.X FPS	
	DELTA VZ (LV)	XXXX.X FPS	
87	DOCKED DAP FLAG SPECIFICATION	OCT	
	CHANNEL 5 JETS INHIBITED	OCT	
	CHANNEL 6 JETS INHIBITED	OCT	
88	PLANET UNIT POSITION VECTOR X Y	-XXXXX	
		-XXXXX	

89 DOCKED DAP RATE
 DOCKED DAP DEADBAND
 .XXXXX
 X.XXXX DEG/SEC
 XXX.XX DEG

90 REND OUT-OF-PLANE PARAMETERS (P3X) Y CM
 Y DOT CM
 Y DOT OWS
 XXX.XX NM
 XXXX.X FPS
 XXXX.X FPS

91 PRESENT OCDU ANGLES - SHAFT
 - TRUN
 XXX.XX DEG
 XX.XXX DEG

92 NEW OCDU ANGLES - SHAFT
 - TRUN
 XXX.XX DEG
 XX.XXX DEG

93 DELTA GYRO ANGLES
 X XX.XXX DEG
 Y XX.XXX DEG
 Z XX.XXX DEG

94 ALTERNATE LOS - SHAFT
 - TRUN
 XXX.XX DEG
 XX.XXX DEG

95 TIG (NC1)
 00XXX. HRS
 000XX. MIN
 0XX.XX SEC

96 REND OUT-OF-PLANE PARAMETERS Y CM
 Y DOT CM
 Y DOT OWS
 XXX.XX NM
 XXXX.X FPS
 XXXX.X FPS

97 SYSTEM TEST INPUTS
 XXXXX.
 XXXXX.
 XXXXX.

98 SYSTEM TEST RESULTS
 AND INPUTS
 XXXXX.
 .XXXXX
 XXXXX.

99 RSS VALUE OF POSITION ERROR
 RSS VALUE OF VELOCITY ERROR
 OPTION CODE
 XXXXX. FT
 XXXX.X FPS
 XXXXX.

CHANGE CONTROL NOTES

REV 00 PCR 010,011,017,018,019,021,032,036,040,413,415,420, SLM #2,19
 REV 01 PCN 489

4.7 THIS LIST REPRESENTS THE CHECKLIST REFERENCE CODES USED WITH V50N25 FOR PRJ33AM SKYLARK.
REV 00 05/19/71

PCR/PCN

R1 CODE ACTION TO BE EFFECTED

00013 PERFORM COARSE ALIGNMENT

00014 PERFORM FINE ALIGNMENT

00015 PERFORM CELESTIAL BODY ACQUISITION

00016 TERMINATE MARK SEQUENCE

00017 PERFORM MINKEY RENDEZVOUS

00020 PERFORM PULSE-TORQUING FOR PLANE CHANGE

00041 SWITCH CM/SM SEPARATION TO UP

00062 KEY CMC TO STANDBY

00204 PERFORM SPS GIMBAL TRIM

SWITCH-DENOTES CHANGE POSITION OF A CONSOLE SWITCH

PERFORM-DENOTES START OR END OF A TASK

KEY IN-DENOTES KEY IN OF DATA THRU THE DSKY

CHANGE CONTROL NOTES

REV 00 PCR 017

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4.8 THIS LIST REPRESENTS THE OPTION CODES USED WITH V04N06 AND V04N12 FOR PROGRAM SKYLARK. REV 00 05/19/71

PCR/PCN

THE SPECIFIED OPTION CODES WILL BE DISPLAYED IN R1
IN CONJUNCTION WITH FL V04N06 OR FL V04N12 TO REQUEST THE
ASTRONAUT TO LOAD INTO R2 THE OPTION HE DESIRES.

R1	OPTION	CODE	PURPOSE	INPUT FOR R2
		00001	SPECIFY IMU ORIENTATION	1=PREF 2= NOMINAL 3=REFSMAT
		00002	SPECIFY VEHICLE	1=THIS VEHICLE 2=OTHER VEHICLE
		00004	SPECIFY STATE OF TRACKING=FULLKFLG	0=RESET (FULL) 1=SET (PARTIAL)
		00012	SPECIFY P50 OPTION	1=ATM SUN SENSOR 2=ATM SJN SENSOR AND ATM STAR TRACKER 3=ATM ANGLES FROM INDEPENDENT SOURCE
		00013	SPECIFY P55 OPTION	1=CELESTIAL BODY AND IMU ORIENTATION 2=CELESTIAL BODY, OPTICS MARK, AND ATM SOLAR-INERTIAL ATTITUDE
		00024	SPECIFY ASSUMED TRACKING MODE	0=RENDEZVOUS (VECPPOINT) 1=TARGET POINTING (VECPPOINT) 2=ROTATION 4=RENDEZVOUS (3AXIS) 5=TARGET POINTING (3AXIS)

CHANGE CONTROL NOTES

REV 00 PCR 013,016,036,413, PCN 457

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4.9 THIS LIST REPRESENTS THE ALARM CODES USED WITH V05N09 FOR PROGRAM SKYLARK.

REV 01 03/20/72

RL	CODE	PURPOSE	SET BY	PCR/PCN
	00107	STAR TRACKER ANGLES OUT OF LIMITS	P55	
	00110	NO MARK SINCE LAST MARK REJECT	SXTMARK	
	00113	NO INBITS	SXTMARK	
	00114	MARK MADE BUT NOT DESIRED	SXTMARK	
	00115	OPTICS TORQUE REQUEST WITH SWITCH NOT AT CMC	EXT VERB OPTICS CDU	
	00116	OPTICS SWITCH ALTERED BEFORE 15 SEC ZERO TIME ELAPSED	T4RUPT	
	00117	OPTICS TORQUE REQUEST WITH OPTICS NOT AVAILABLE (OPTIND=-0)	EXT VERB OPTICS CDU	
	00120	OPTICS TORQUE REQUEST WITH OPTICS NOT ZEROED T4RUPT	SXTMARK	
	00121	CDU'S NOT GOOD AT TIME OF MARK	SERVICER	
	00205	BAD PIPA READING	IMU MODE SWITCH IMU 2	
	00206	ZERO ENCODE NOT ALLOWED WITH COARSE ALIGN + GIMBAL LOCK	T4RUPT	
	00207	ISS TURNON REQUEST NOT PRESENT FOR 90 SEC	IMU MODE SWITCH, IMU 2, R02, P51, P53	
	00210	IMU NOT OPERATING	IMU MODE SWITCH-1	
	00211	COARSE ALIGN ERROR-DRIVE >2 DEGREES	IMU MODE SWITCH, T4RUPT	
	00212	PIPA FAIL BUT PIPA IS NOT BEING USED	T4RUPT	
	00213	IMU NOT OPERATING WITH TJRN-ON REQUEST	T4RUPT	
	00214	PROGRAM USING IMU WHEN TURNED OFF	P51, P52, P53, P54	
	00217	BAD RETURN FROM STALL ROUTINES	R02	
	00220	IMU NOT ALIGNED (BAD REFSMMAT)	INF ALIGN, IMU2, R61	
	00401	DESIRED GIMBAL ANGLES YIELD GIMBAL LOCK	P52	
	00402	ENTER RESPONSE NOT ALLOWED		

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00404	TARGET OUT OF VIEW (TRUN. ANGLE > 90 DEG)	R52
00405	TWO STARS NOT AVAILABLE	P52,P54
00406	RENJ NAVIGATION NOT OPERATING	R23
00421	W-MATRIX OVER FLOW	INTEGRV
00500	NOT ENOUGH JETS FOR SOME PITCH OR YAW ROTATION	DOCKED DAP
00501	NOT ENOUGH JETS FOR SOME ROLL ROTATION	DOCKED DAP
00600	FAILURE IN PHASE MATCH ITERATION	P31,P32
00601	FAILURE IN HEIGHT MANEUVER ITERATION	P31,P32
00602	FAILURE IN OUTER LOOP ITERATION	P31,P32
00603	FAILURE IN QROTPI ITERATION	P31,P32,P33
00611	NO TIG FOR GIVEN ELEV ANGLE	P34,P35
00777	PIPA FAIL CAUSED THE ISS WARNING	T4RUPT
01102	CMC SELF TEST ERROR	SELF CHECK
01105	DOWNLINK TOO FAST	T4RUPT
01106	UPLINK TOO FAST	T4RUPT
01107	PHASE TABLE FAILURE. ASSJME ERASABLE MEMORY IS DESTROYED	RESTART
01301	ARCSIN-ARCCOS INPUT ANGLE TOO LARGE	INTERPRETER
01407	VG INCREASING	S40.8
01426	IMU UNSATISFACTORY	P61,P62
01427	IMU REVERSED	P61, P62
01520	V37 REQUEST NOT PERMITTED AT THIS TIME	V37
01600	OVERFLJW IN DRIFT TEST	OPT PRE ALIGN CALIB
01601	BAD IMU TORQUE	OPT PRE ALIGN CALIB
01703	INSUFFICIENT TIME FOR INTES., TIG WAS SLIPPED.	R41
03777	ICDU FAIL CAUSED THE ISS WARNING	T4RUPT

04777	ICDJ, PIPA FAILS CAUSED THE ISS WARNING	T4RUPT	
07777	IMU FAIL CAUSED THE ISS WARNING	T4RUPT	
10777	IMU, PIPA FAILS CAUSED THE ISS WARNING	T4RUPT	
13777	IMU, ICDU FAILS CAUSED THE ISS WARNING	T4RUPT	
14777	IMU, ICDU, PIPA FAILS CAUSED THE ISS WARNING	T4RUPT	
20430	* INTEG. ABORT DUE TO SUBSURFACE S.V.	ALL CALLS TO INTEG.	
20607	* NO SOLUTION FROM TIME THEIA OR TIME RADIIJS	ALL CALLS TO ROUTINE ROUTINE	
21204	* NEGATIVE OR ZERO WAITLIST CALL	WAITLIST	
21206	* SECOND JOB ATTEMPTS TO GO TO SLEEP VIA	PINBALL	
	KEYBOARD AND DISPLAY PROGRAM		
21210	* TWO PROGRAMS USING DEVICE AT SAME TIME	IMU MCDE SWITCH	
21302	* SORT CALLED WITH NEGATIVE ARGUMENT	INTERPRETER	
21501	* KEYBOARD AND DISPLAY ALARM DURING INTERNAL	PINBALL	
	USE (NVSUB)		
21502	* ILLEGAL FLASHING DISPLAY	GOPLAY	
21521	* P01 ILLEGALLY SELECTED	P01	
31104	* DELAY ROUTINE BUSY	SERVICE ROUTINES	
31201	* EXECUTIVE OVERFLOW-NO VAC AREAS	EXEC	
31202	* EXECUTIVE OVERFLOW-NO CORE SETS	EXEC	
31203	* WAITLIST OVERFLOW-TOO MANY TASKS	WAITLIST	
31211	* ILLEGAL INTERRUPT OF EXTENDED VERB	SXTMARK	
32000	* DAP JASK STILL IN PROGRESS WHEN	DOCKED DAP	
	NEXT JASK ATTEMPTED		
	* INDICATES ABORT TYPE. ALL OTHERS ARE NON-ABORTIVE.		
	2XXXX INDICATES A GO TO ROUTINE 00 TYPE ABORT (IF EXTENDED VERB ACTIVE OR IF AVERAGE G ON DO		489
	BALOUT TYPE ABORT)		
	3XXXX INDICATES A BALOUT TYPE ABORT		

NOTE: FOR V05 N09 DISPLAYS:
 R1-XXXXX (FIRST ALARM FOLLOWING ERROR RESET).
 R2-XXXXX (SECOND ALARM FOLLOWING ERROR RESET).
 R3-XXXXX (MOST RECENT ALARM)

ERROR RESET WILL SET R1 AND R2 TO ZERO, BUT
NOT AFFECT R3

CHANGE CONTROL NOTES

REV 00 PCR 016,036,448,454, PCN 457
REV 01 PCN 489

SKYLARK 1 (GSOP)

R693

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